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CHANGES IN INTERNATIONAL ELECTRICAL STANDARDS.

As a result of the work of the representatives of the various national standardizing laboratories who met in Washington last spring, changes have been announced by the Bureau of Standards in the values of the electrical standards which are maintained by them, and the foreign standardizing laboratories are reported to be making the same changes. This announcement was made by Dr. E. B. Rosa at the meeting of the American Association for the Advancement of Science held in Minneapolis last week, and reported upon other pages of this issue.

At the International Conference held in London in 1908 it was decided to make the international ohm and ampere the two primary electrical units, and to derive the value of all other electrical units from these. The saturated Weston cell was adopted as a standard of electromotive force, but its value was not stated, but was to be determined from the other two units. The specifications according to which this cell should be set up and also the specifications which should be followed in making use of the silver coulometer in determining the value of the international ampere, were left to an international committee, and it is understood that this committee has taken action upon the basis of the work of the representatives of the four governments which maintain standardizing laboratories. As a result of the work of these representatives the value 1.01830 volts has been assigned to the saturated Weston cell at the temperature of twenty degrees centigrade. This value is lower than the value heretofore used by the Bureau of Standards by 0.08 per cent and is slightly lower than those used in Europe. The value of the resulting unit of measurement is therefore larger. Since the value of the ampere at the Bureau of Standards has been derived from the value of the volt, this standard is to be changed by the same amount. The value of the watt, which is affected by both the volt and the ampere, will therefore be increased by 0.16 per cent.

The legal value of the electrical units in this country was fixed by Act of Congress passed in 1894, which defined the various units in conformity with action taken at the International Electrical Congress held in 1893 in Chicago. It was unfortunate that in this act concrete values were assigned to the three units, volt, ampere and ohm, although

it was the evident intention of the framers of this measure to regard the concrete definitions of the international ohm and ampere as primary definitions and that the value of the volt was one given as a matter of convenience and as representing the best knowledge at the time, the unit, however, to be derived from the ohm and the ampere.

Since its organization, however, the Bureau of Standards has seen fit to make use of the concrete definitions of the international ohm and volt stated in the above act, with the result that these standards for volt and ampere have differed considerably from those in use in Europe, owing to the fact that the value 1.434 volts assigned to the Clark cell was found to be not in conformity with the definitions of the other units. The change now being made in the units maintained by the Bureau of Standards probably brings them into the best agreement with the existing law that could be obtained, and the change does not represent any change in the legal unit, but only a better approximation to this unit than has heretofore been reached. Obviously the value of the legal units has not been altered, since these units were fixed by the Act of Congress and no change has yet been made by that body. The change is one of standards, not of units.

The changes in the standards for the volt and the ampere are too small in value to appreciably affect engineering measurements made upon current or voltage. The value of the standard for power measurement, however, is affected to twice the extent of the other standards and the amount is sufficient to be read upon most indicating wattmeters. The calibration of these instruments will consequently be thrown out by more than one-tenth of a division. It will be necessary for all those making use of potentiometers and other accurate measuring instruments to make an adjustment in the apparatus corresponding to the change made in the standard, or else to make a suitable correction whenever measurements are being made. In most measurements with watt-hour-meters, especially in the case of general supply meters, the change may be neglected since most of these instruments are not depended upon for an accuracy equal to the change involved.

According to the announcement made, these changes are to go into effect at once. It would have been a great convenience, especially to the manufacturers of instruments, if this change had been announced some months before it was put into effect, as instruments calibrated for future use could then have been adjusted to the new standards. As it is, it is probable that many instruments which have been prepared for use and have been waiting in the stock room will have to be readjusted before they can be sent out for use. This will entail some little inconvenience. Another reason for an advance announcement is that it takes some appreciable time for the news to reach all users of instruments, whereas if all could know of the change in advance confusion could be avoided.

GREAT ADVANCES IN LONG-DISTANCE TELEPHONY.

On other pages of this issue we chronicle the description of some very important work carried out during 1910 in improving and extending long-distance telephony by the American Telephone & Telegraph Company. As the result of the most brilliant experimentation it has been discovered that an enormous mileage of "loaded" circuits can be successfully "phantomed," increasing the wire facilities without substantial increase in cost. Refinements in installation of outside equipment, special study of the problem of insulation, transposition and terminal arrangement, have reduced transmission losses to such a degree that telephonic communication to all long-distance points will be greatly improved.

Not so long ago, in a sketch of the career of John J. Carty, chief engineer of the American Telephone & Telegraph Company, it was stated that trans-continental telephony was this man's objective. It is therefore with a good deal of pleasure that we find it possible to announce that work has progressed so far on the New York-Denver circuit that the theory upon which it is based is found to be sound, and the computations are correct. Not only is this the most remarkable circuit yet attempted for distance of transmission, but it will be possessed of other characteristics which up to the moment have seemed far in advance of the telephone engineer's most sanguine expectations.

The highly specialized engineering resources which have contributed so splendidly to the development of telephone facilities will now, through the alliance of the American Telephone & Telegraph Company with the Western Union Telegraph Company, be applied to the telegraph, and it may be expected, with every assurance of successful fruition, that the further study of combined telephone and telegraph working will yield developments of a more important nature than any heretofore accomplished.

CARBON FOR HIGH RESISTANCES.

The use of carbon in one form or another for high resistances, particularly for laboratory use, has been in vogue for some time, and many attempts have been made to make such resistances in a form sufficiently permanent to serve as secondary standards of high value. Little success has attended the efforts in the latter direction, but resistances for rheostatic purposes merely have been made and proved quite convenient, as the necessary high resistance has been secured with sufficient definiteness in compact form.

Rods of graphite are available up to values of about a megohm. Lead-pencil marks on paper, ink marks on porcelain, and various other expedients have been resorted to. The latest proposal is to rule lines with waterproof India ink on heavy paper, and as reported by Mr. F. A. Aust at the Minneapolis meeting last week, such resistances prove very satisfactory. For smaller resistances, the paper is soaked in the ink one or more times.

INDIVIDUAL MOTOR DRIVING IN THE TEXTILE INDUSTRY.

The increasing use of the individual motor drive in the textile industry is one of the most significant developments in the field of cloth manufacture at the present time. For nearly twenty years group driving has been employed in cotton mills, although the past decade has witnessed the most remarkable installation of electrical methods in widely scattered portions of the country. In practically every case where the electric drive has been put in it has increased the rate of production through the maintenance of steadier running conditions, and it is the best possible testimonial of the value of electric power to the textile producer that not a single installation is in mind where motors once placed in service have been withdrawn. It is the universal experience that extensions of electrically operated mills are invariably driven by motors, except in the rare cases where a peculiar hydraulic layout justifies the continuance of a simple water-power drive. Even here there is a growing tendency for mill owners to install motors on the water-wheel shaft, and in times of low water to drive them by electricity from the reserve steam plant, thus giving a permanent source of motive power on the shaft driving the textile machinery. In other installations making use of water power with a reserve steam plant, arrangement is made for coupling either the water turbines or the steam units to the main shaft.

The benefits of individual drive are so well known that they need not be rehearsed. Every advantage due to the use of electricity is multiplied when the last belt is cut away and the machine driven by a separate motor. On account of the high first cost of a large installation of very small motors individual driving has naturally developed mainly along the lines of equipping the larger textile machines for direct operation. In many mills there are several hundred looms driven by separate motors, and all along the line from the picker room to the shipping department are opportunities for driving good-sized equipment by electricity without the use of cumbersome shafting and belt connections. Pickers, drawing frames, warpers, fly frames, and looms are particularly susceptible to the benefits of the individual motor application. Improved location of machinery in relation to the production processes, subdivision of power to eliminate large friction losses when departments power to eliminate large friction losses when departments are running underloaded, and the avoidance of injury to high-companied the use of separate motors throughout the entire industry. In these direct-connected applications much ingenuity has been shown by the motor manufacturers in the development of compact methods of mounting the driving apparatus on the textile frame, the number of bearings being cut to the minimum, in many instances the motor being mounted practically inside the gearing and shaft connections of the machine. On account of the almost universal use of the induction motor in the textile field it is not necessary to expose the working parts of the electrical equipment to the close inspection needed in direct-current service, and the motor can be fitted to the machine with almost no regard to the requirements of electrical maintenance. When the machine is driven by a silent chain or geared connection there is no slip, and hence the production rate can be maintained at the highest point under all conditions consistent with the quality of material being handled.

The direct driving of drawing frames has resulted in noteworthy economies in production. In the latest work of this kind the silent chain is widely employed; there is a saving of perhaps twenty per cent in power while the frame is in operation; all quarter-turn belts and other shafting complications are avoided; and easy control is effected through switches attached to the shipping handles. The tendency of drawing frames is to start with considerable stiffness, and hence where these are belt-driven, it is necessary to draw the belts to a degree of tightness which cannot ordinarily be maintained in service. Loss in the rate of production is almost inevitable without the use of individual motors. Similarly, in the driving of warpers, much time has been saved by the use of electricity, since these machines handle the material at a stage where it is especially delicate, and with the motor drive it is no longer necessary to take a long time to slip on the belts and start the equipment with extreme gentleness. The driving of spinning frames appears to be in the main best solved at present by the use of motors in groups, although a close approximation to individual driving is effected by the use of the so-called four-frame drive, in which a motor located on a ceiling or overhead platform is fitted with four pulleys, two being on each end of the rotor shaft. While this is a compromise solution, the cost is moderate, and the amount of slip, confined as it is to the single belt line between each pulley and the corresponding frame, is not excessive. In loom work many successful applications have been made of individual motors, and where the cost of looms for the production of very high-class material is high, as in certain imported makes used in the lace industry, any other drive than the direct-connected motor would be out of the question, on account of the inability of belts to maintain the maximum rate of production many hours out of each day and night. With electricity, automatic stopping motions can be attached in the most convenient manner; the cleanliness of a "no-belt" installation cannot be realized until it is compared with the old type of driving; and the safety to the employee is increased. The absence of dust in the weave room which is driven by small individual motors, the quick control of the machinery, and above all the rise in production rate are potent arguments in favor of direct driving. Competition will force its adoption even more widely in the future.

Electric Vehicle Association of America.

More than 200 persons attended the December meeting of the Electric Vehicle Association of America, held at the Engineering Societies Building, New York City.

W. E. Holland presented a paper on "The Alkaline Battery" and R. E. Russell one on "The Mercury-Arc Rectifier for Charging Electric Vehicles." Both papers were illustrated, and were followed by a very general and interesting discussion. W. H. Blood, Jr., presided. Among those who spoke in the course of the discussion on the papers were, Arthur Williams, of the New York Edison Company; R. M. Searle, of Rochester; Frank W. Smith, of the United Electric Light & Power Company; P. D. Wagoner, president of the General Vehicle Company; W. P. Kennedy, of the Studebaker Automobile Company; C. D. Marsh, Alexander Churchward and Charles Blizard.

Chicago Rejuvenation and Jovian Dinner.

Plans are rapidly being completed for the rejuvenation and Jovian dinner, which will be held in Chicago on Tuesday, January 17, at the Auditorium Hotel. The committees are actively at work, and it is expected that a most successful initiation and collation will be the result of their efforts. The degree team is prepared to carry the floor work through in the most approved style, and the program committee, headed by Frederic P. Vose, toastmaster, promises a series of fine addresses. The Jovian dinner will be held prior to rejuvenation, and the guests will be seated at 6 p. m. sharp.

Utah Society of Engineers.

The monthly meeting of the Utah Society of Engineers was held at the Commercial Club, Salt Lake City, on Tuesday, December 20, 1910. R. B. Ketchum, of the University of Utah, presented a paper upon "The Economic Design of Reinforced Concrete Beams and Slabs." Immediately preceding the meeting about sixty members of the society and their friends were present at a "Get-Acquainted Dinner" served in the Commercial Club's new building.

On Saturday, November 26, 1910, the Society made an inspection of the lines of the interurban railways between Salt Lake City and Brigham City, Utah. Stops were made at Willard, Ogden Canyon, Lagoon and Brigham City to see power plants and substations. The trip was made in a special car chartered for the purpose.

Annual Meeting of the New York Electrical Credit Association.

The annual meeting of the New York Electrical Credit Association was held on December 13 at the Railroad Club, Hudson Terminal Building, New York City.

The election of officers, which took place at this meeting, resulted as follows: President, W. B. Wallace, of the Western Electric Company, succeeding P. M. Haight, of the Sprague Electric Company; directors, V. S. Kalby, of the American Ever Ready Company, and F. A. Wurzbach, of Francis Keil Company.

The hold-over directors are John H. Dale, of the Dale Company; W. H. Roberts, of W. R. Ostrander & Company; W. C. Hall, of the New York Insulated Wire Company; B. H. Ellis, of the Manhattan Electrical Supply Company; and W. B. Wallace. A. L. Miller, of the John A. Roebling's Sons Company was re-elected representative on the Board of Managers of the National Electrical Credit Association.

The Minneapolis Electric Show.

Announcement is made that the 1911 Northwestern Electrical Show will be held at the National Guard Armory, Minneapolis, Minn., January 26 to February 4. This will be the second annual show under the auspices of the Northwestern Electric Show Association and it is promised that the show of last year will be eclipsed in point of electrical, decorative and entertainment features.

Many special features have been arranged for, including spectacular exhibitions by Prof. H. T. Plumb in high-frequency phenomena.

Nearly all the space in the armory auditorium has been sold to exhibitors and it is now predicted there will be fully fifty per cent more in line for booths and space to exhibit than signed up for the first annual show. Rossiters' military band has been engaged for the week and Manager R. W. Clark is closing contracts for other good features for the entertainment department of the show.

International Municipal Congress and Exposition.

The Hon. John MacVicar has been selected for the position of Commissioner-General of the International Municipal Congress and Exposition, to be held in Chicago, September 18-30, 1911.

John MacVicar is the best known authority in this country on all that pertains to municipal government and the administration affairs of cities. He has been in active service in municipal work for more than twenty years. He was named to the office of president of the League of American Municipalities upon its organization, fifteen years ago, and has ever since been actively connected with that organization, for the past ten years as secretary.

Mr. MacVicar is at present a member of the commission, and superintendent of streets and public improvements, at Des Moines, Ia., which city has recently attracted much attention because of its advanced form of government.

This congress and exposition, above referred to, will cover in a practical as well as theoretical manner matters of interest to all branches of municipal service. Upon each day of the congress papers will be read and discussed by prominent municipal officials, and prominent municipalities of this country and foreign countries will have attractive exhibits of municipal undertakings in which they excel. The manufacturers of municipal appliances will have elaborate exhibits that will interest and instruct municipal officials everywhere.

Exposition of Inventions at St. Louis.

An International Exposition of Inventions will be held in St. Louis, Mo., during the week of April 10, 1911. The object is the demonstration and promotion of patented machines, appliances, devices, tools and processes of every character. The manager is William Keane Small, 511 New Bank of Commerce building, St. Louis, Mo.

Need for Telephones.

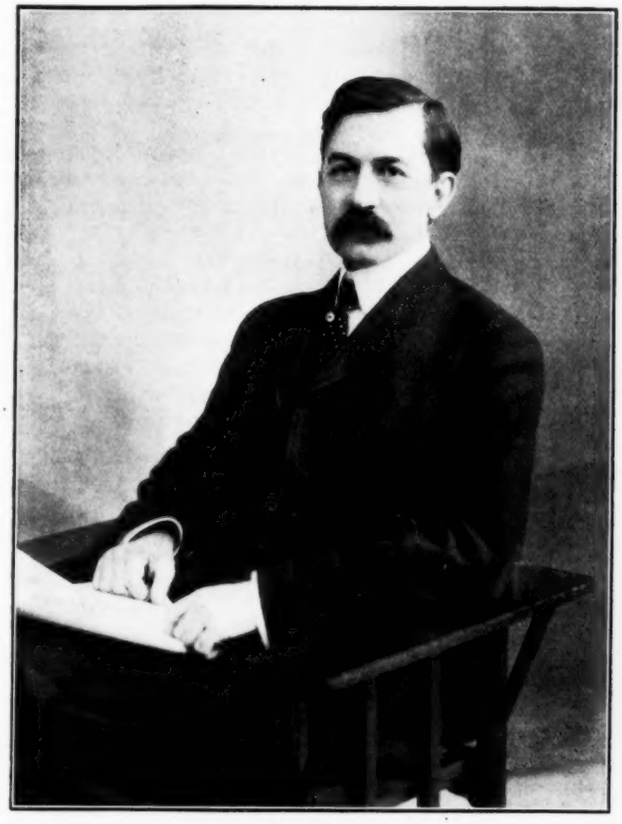
The city of Bombay, India, with nearly 1,000,000 inhabitants, has less than 2,000 telephone subscribers and no long-distance lines. It must be remembered, however, that time is not of such importance there as in the United States. The lack of a common language is also a great drawback to telephone development.

James G. White.

Upon various occasions the attempt has been made to define the exact meaning of the word "engineer." From the dictionary standpoint the word is perhaps easy of definition, and in a rather common way the true meaning is perhaps best understood as "one who does things." All around this commonplace there have been built up many flowery expressions, but after all the circumlocution the homely expression fits the case best.

The subject of this sketch, James G. White, is a man who does things. He is an engineer by every instinct within him and his prowess is well known in the four great divisions of the world. His engineering achievements have brought comfort, industry and profit in the United States, Great Britain, Europe, Asia, Australia and in North and South America.

James Gilbert White was born at Milroy, Pa., August 29, 1861, the son of the Rev. J. W. and Mary M. (Beaver) White. He graduated from the Pennsylvania State College and was valedictorian for his class, receiving the art degree in 1882. He received the master's degree in 1885. He was a fellow of Cornell University in 1884 and 1885, and received the degree of Ph. D. in 1885. He was instructor of physics at the University of Nebraska from 1885 to 1887, and president of the Western Engineering Company in 1887 and 1890. He established his business in New York in 1890, in London in 1900 and his Canadian Company in 1905. He is president and director of J. G. White & Company, Inc., of New York; chairman and director of J. G. White & Company, Ltd., London; chairman and director of the Canadian White Company, Ltd., of Montreal; director of the Waring-White Building Company., Ltd., of London; president and director of the Engineering and Electrical Securities Company, director of the Manila Electric Railway & Lighting Company, of the Philippines Lighting Company, of the Netherland Tramways Corporation, Eastern Pennsylvania Railway Company, Porto Rico Railways Company, Ltd., Helena Light & Railway Company, and a number of other public service and industrial corporations.



J. G. WHITE,
President of J. G. White & Company, New York.

Early in his career Mr. White devoted himself to the solution of electric traction problems and it was at Kearney, Neb., soon after his college work was completed, that he installed a system of electric railways originating a three-wire system of distribution, with 220 volts on each side. This installation brought him prominence and he became connected with the Edison General Electric Company, taking entire charge of its installation department for the United States. His first big independent work and one that placed him in the front rank of the world's great engineers, was the design and construction of the Buffalo & Niagara Falls Electric Railway. Here was the initial installation of the four-motor equipment with series-multiple control. This was followed by commissions for important installations at Kalgoorlie in Western Australia and in other parts of the Eastern and Western hemispheres. This work included tramways in a score of great cities in Europe, Asia and South America, and in Bombay, Lille, Amsterdam, Belfast, Montevideo, Buenos Ayres, and the Philippine Islands. Mr. White also engineered and built the harbor improvements at the ports of Iloilo and Cebu, where the Insular Government expended a million dollars on these harbors. His architectural work in Great Britain is represented by the great buildings of the Hotel Ritz, in London, and the Liverpool Cotton Exchange. The Canadian Company has constructed the Royal Bank of Canada, St. John, New Brunswick, the great street railway power plant in Montreal, and public buildings, waterworks and power stations in a dozen other Canadian cities. One of his most recent undertakings in the United States is a tremendous irrigation proposition, including a dam, collecting and distributing system, near Denver, Colo., under the immediate supervision of the Denver Reservoir and Irrigation Company.

At the time of the St. Louis Exposition, Mr. White was appointed by the Government as a member of the Railway Test Commission. He was made chairman of this commission, whose purpose it was to investigate and report upon the construction and operation of street and interurban railways in this country.

He is a member of the Chamber of Commerce, of New York City, American Society of Civil Engineers, Institution of Electrical Engineers of Great Britain, American Museum of Natural History, National Geographic Society, trustee of Pennsylvania State College, member of the Pilgrims Society, Pennsylvania Society, Sons of the Revolution, and his clubs include the University, Metropolitan, Engineers, Lawyers, New York Athletic, Cornell University, Columbia Yacht, in New York, Maryland Merchants, of Baltimore, and Ranelegh of London.

ELECTRIC LIGHTING AND LUMINOUS EFFICIENCY.

DISCUSSION BY PITTSBURG SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The December meeting of the Pittsburg section of the American Institute of Electrical Engineers was the best attended of the season, and the 125 persons present were well repaid for attending. The general topic of the meeting was "Electric Lighting and Luminous Efficiency." Two papers were presented, one by Dr. E. P. Hyde on "A Study of the Electric Incandescent Lamp," and one by F. R. Fortune on "Luminous Efficiency as Affected by the Quality of the Light."

In these papers the different energy losses of a light-giving source were discussed and their relation to the luminous efficiency shown. The loss by convection was illustrated by curves showing the energy necessary to maintain a platinum filament at a constant candlepower, while the degree of exhaustion was varied. This loss of energy becomes very small at much higher pressures than those used in incandescent lamps. At atmospheric pressure the total watts per candle were several times as great as at low pressures. The direct interest of this in connection with the incandescent lamp is to show the necessity of the high vacuum, though in those types of lamps burning at atmospheric pressure, such as the Nernst, convection is an important part of the loss. The loss by conduction along the filament to the supports was illustrated by curves showing the energy radiated from each portion of the length of a tungsten filament. The cooling action for a few millimeters from the ends was strikingly illustrated. This loss, however, averages but five to ten per cent of the total energy received by the filament.

The greatest loss of energy is by the radiation at wave-lengths not visible to the eye. At the temperature reached by the incandescent filament, by far the greater part of the radiation is at a frequency below that of the very narrow part of the spectrum visible to the eye. If it were possible to operate a filament at between 5,000 and 6,000 degrees centigrade, the temperature of maximum luminous efficiency of an incandescent body would be attained. At this temperature the radiation in the visible spectrum is the greatest in proportion to the total, and may reach something like fifty per cent of this total. At this temperature, the light emitted is actually white. At a higher temperature it would be bluish, and at a lower temperature, it is yellowish. Curves were shown illustrating this beautifully. The radiant energy emitted is seen to reach a sharp maximum at a frequency depending on the temperature, and at the temperatures attainable the radiation is much greater at the red end of the spectrum than at the blue. The reason for the great increase of efficiency with increase of temperature is the shift of the frequency of maximum radiation toward the visible spectrum.

Selective radiation was explained from the same curves. Some bodies emit a greater proportion of the radiation at the higher frequencies than the standard "black body." This makes not alone for higher efficiency but for whiter light. It is difficult to prove selective radiation, due to the difficulty of measuring the high temperatures of the filaments. However, a simple experiment was shown tending to prove the selectivity of the tungsten filament. This is its lesser variation of candlepower with the watts input as compared to a carbon lamp. This was readily observable to those present.

Another experiment illustrating the high efficiencies actually possible was shown by burning some fifty-volt lamps at overvoltage. Some carbon lamps at about 110 volts were made to far exceed the ordinary tungsten in efficiency, but burned out in less than two or three seconds. Some tungsten lamps lasted a few seconds at 220 volts giving an enormous amount of light at a very high efficiency. The limit to the temperature of a carbon filament is the evaporation from its surface which is very rapid at temperatures considerably below the melting point and which is what determines the life at the ordinary working voltage of the lamp. The actual melting point of carbon is probably reached only in the electric arc. Due to the lower vapor pressure of tungsten, it is possible to work much closer to its melting point without excessive evaporation, and a great overvoltage will melt rather than vaporize the tungsten.

Curves were shown illustrating the luminous effect of radiation of different wave-lengths. It was seen that that portion of the visible spectrum near the red or the violet is very ineffective in producing the sensation of light, it requiring about five times as much energy as is required in the middle of the spectrum to produce the same degree of light sensation. The eye sensibility falls off very rapidly near the limits of the visible spectrum. It is thus seen that the maximum light efficiency would be obtained by confining radiation to a single wave-length. While such a light would have several times the efficiency of a white light, it would be useless for ordinary purposes due to its single color and consequent entire change of the appearance of colored objects.

The Mechanical Handling of Freight.

A paper on "The Mechanical Handling of Freight," by Samuel B. Fowler, of Boston, will be presented at the New York meeting of the American Society of Mechanical Engineers on Tuesday, January 10. The subject will be discussed by railroad officials and by officers of large industrial establishments where the handling of great quantities of freight is a serious problem.

Old-Age Pension for Public-Service-Corporation Employees.

A pension system, together with life insurance and sick or disability benefits, was put into effect by the Public Service Corporation of New Jersey and allied companies, January 1. The benefits will cover all the permanent employees of the street-railway, gas and electric companies, including those acquired during the past year. The expenses are to be borne wholly by the employing companies. About 10,000 men will be affected and the cost of the scheme will, for the first few years, be at least $50,000 a year. Later it will be more. Provisions are made for pensions, based on percentages of wages or salary, with the minimum fixed at $240 per year. As sick or accident benefits one dollar a day will be paid during disability, not exceeding ninety days in any one year, and the insurance payable on the death of an employe will be $300.

Voluntary retirement at sixty-five years of age and after twenty-five years of continuous service and compulsory retirement at seventy, after twenty years' service, are provided for.

A Review of the Year in the Electrical Industry.

While the present year has been fairly satisfactory in its evidence of a recovery from the abnormal falling off of a year ago, there has been nothing startling either in scientific research, in physical development, in manufacturing or in installation. In fact, a cold analysis of the electrical industry during the last six months indicates that there is considerable disappointment over the net geains made. It is true that in several directions, such as in the manufacture of incandescent lamps, the sale of small motors, and in the production of alternating-current apparatus of various dimensions there has been a considerable gain, but the field on the whole has not responded as the really enthusiastic rebound which was evident during the first six months of 1910 gave promise.

In the following pages a review will be given of the outstanding developments which have appeared with respect to the several great divisions of electrical endeavor. This review is based upon a careful study of the announcements which have appeared in the technical papers from time to time and also upon the opinions which have been recently expressed by the leaders in each of the great departments of the industry.

Telephony and Telegraphy.

The merger of the interests of the American Telephone & Telegraph Company with those of the Western Union Telegraph Company, the changes in the personnel of the latter organization, and the introduction of several features looking to increasing the efficiency of telephone and telegraph service have undoubtedly been of the utmost importance in connection with this department of electrical work during the past year. The "night letter" has greatly increased the traffic and incidentally brought to the treasury of the telegraph companies a revenue which is practically a new expenditure upon the part of those already making extensive use of both telephone and telegraph communication.

Automatic telephony has gained favor, but it is in the direction of using combinations of automatic and manual systems where the greatest gain is being made. Increasing the effectiveness of long-distance communication has engaged the attention of the American Telephone & Telegraph Company, and in a quiet way a great deal has been done to render long-distance facilities very complete. The important features of this work are comprehensively described on page 43 of this issue. At the opening of the new year word comes from Washington of the duplexing of a single circuit.

Telephone train dispatching has reached rather remarkable proportions during the past year, and the great success which this departure has achieved is going to win for the telephone a much more secure position in this very severe service. There have been many elements which have contributed toward the necessity for a change in the methods of conducting telephone train dispatching. In this connection, however, but two features need be commented upon. The first is the desirability of the telephone method of communication where the direct conversation is carried out, the instructions given and the reply received. The other is the growing scarcity of trained operators and the unfortunate disposition upon the part of those who are employed to urge rather restrictive measures against their employers. Outside of this, of course, it is the production of highly efficient telephone and auxiliary equipment that has rendered the change commercially satisfactory.

In connection with the utilization of the telephone in train dispatching there appears to be another direction in which the telegraph is going to witness a change. Under the new condition of affairs it is quite possible that there will be quite a rapid introduction of perfected systems of machine telegraphy. Where telephone systems are utilized for telegraphing, the telegraph system will be bettered automatically because the circuits and construction used in telephone equipment are generally of a better type. In addition to this better equipment, a speedier method of transmitting and receiving the telegraphic impulses will add greatly to the popularity of this service.

In this direction it is interesting to note a rather important development in the working of telegraph lines. This is the improved quadruplex system of the Western Union Telegraph Company. For many years past quadruplex working has been limited to comparatively very short lines, principally for the reason that the obligatory introduction of underground and aerial cables into such circuits increased the electrostatic capacity and inductive interference to such an extent as to render four-corner working with the old style of quadruplex apparatus impracticable. With the advent of different and more efficient types of apparatus on both the sending and receiving sides the working margin has been increased to an extent sufficient to render quadruplex working feasible over the longest and most difficult telegraph lines. The principal factors concerned in bringing about this successful result consist of a rapid-acting pole-changing device that minimizes the "interval of no current" and a neutral relay provided with a holding coil which is energized by the discharge of an impedance coil during the intervals of no magnetism in the neutral relay.

In cable work it is not feasible to report any new developments, although there is some work being done with a view to accelerating and improving the operation of submarine cables. These may eventually meet with a measure of success, but the systems are still in an experimental stage.

In the manufacture of cables there is little information of a new nature except that which has been developed with regard to cable terminals. There are many inquiries for high-voltage cables, but there seems to be no especial demand to use more than about 22,000 volts. One of the largest manufacturers of cables is experimenting with a new kind of cable and with various materials.

Wireless Telegraphy and Telephony.

The most marked development of the year has been the general adoption of the quenched spark which was used in this country in 1899, and is now coming to the front again. The quenched spark has the advantage of utilizing a larger part of the energy in the aerial, an electrical efficiency of sixty to eighty per cent being attained. The operation is noiseless and the wave trains are much more persistent. Even the rotary gap is being abandoned in its favor in some cases, although it has not yet been used in the high-power stations. With its use it is necessary to have appropriate coupling. A loose coupling is becoming more general in receiving apparatus.

Selectivity is receiving more and more attention and tuning within narrower limits is being attained. The use of a high-pitched spark also increases the efficiency, since it reduces the antenna potential for the same energy. Complicated receiving circuits are being abandoned, with a return to the simple two-circuit tuner, as the latter is capable of giving as good tuning as the more complex circuits.

A method has been proposed by Peukert by which several arcs can be used in series to increase the sending energy.

The above advances in efficiency and tuning mark the approach of the time when wireless will really compete with wire lines and cables. The Marconi Company has resumed transatlantic service during the year and signals have been received by its station in Argentine Republic from Nova Scotia and from Ireland, a record distance of 5,600 miles. Signals have been received by daylight at sea over a distance of 3,500 miles. A ship has been in constant communication with Hamburg, Germany, on a trip to South Africa, the distance covered being 4,000 miles, largely over land. The Pacific Ocean has practically been covered, as ships have been in communication with Honolulu over almost the entire journey from North America to Australia. Signals have been reported to have been received from the California coast on shipboard at a distance of 4,580 miles. Overland transmission between Chicago and the Atlantic coast has been in successful operation. The transmission of 250 words a minute can now be carried on, irrespective of interference and of weather conditions. The range of operation has been largely increased by the telephone relays of Brown and Pickard, and these also enable a greater sharpness of tuning. Good working communication has been maintained between ships of the Navy Department with ten-kilowatt sets over a distance of 600 miles in the daytime and signals could be detected at a distance of 1,000 miles. The Bellini-Tosi directed system has proved successful with ships in the French Navy, but the range is limited and the use of short waves is necessary.

The use of solid rectifiers in detecting apparatus has largely supplanted other types. Rossi has invented a receiver based upon the Wiedemann magnetic effect. A new electrolytic detector, making use of an amalgam of tin, has also been brought out, as well as the valve receiver of Marconi.

Another novelty is the call signal system of the Telefunken Company, by which the call signal can be received at a station over as great a distance as it can easily communicate audible signals. This is done by accumulating the effect of incoming signals over a considerable period of time upon a sensitive but sluggish relay.

The use of resonance transformers in the supply circuit is advocated by foreign engineers. These give a large magnetic leakage. The mutual inductance should be variable, and it has been found that coreless transformers for this purpose are very efficient; in fact, more efficient at frequencies as high as 500 cycles than those with the iron core. Among American engineers it has been more customary to adjust the secondary capacity.

The use of wireless apparatus has been successfully accomplished upon balloons, aeroplanes, submarine vessels and railroad cars.

There have been few developments in wireless telephony during the year. Attempts have been made to produce reliable apparatus which shall not require adjustment and can be used by untrained persons. Telephoning by wireless has been carried on on French vessels over a distance of sixty-nine miles, and it is reported that Fessenden in this country has telephoned over a distance of 200 miles.

A scheme of wireless control of signals for railroad trains has been designed and can be applied to double-track roads. This removes trouble from stray currents and broken down insulators.

Electric Lighting and Illuminating Engineering.

Although there were no very startling developments in the field of electric lighting during the past year, there was marked progress in nearly all branches of the industry, particularly in the manufacture of electric lamps and their appurtenances, great extension of the use of electric light, and far more intelligent employment of it for illumination. Many features of these three lines of improvement have been pointed out in the excellent reviews by Dr. Bell and Mr. Scott on other pages of this issue, so it will suffice here to call attention to those features not touched on in their articles.

In incandescent lamps the most noteworthy improvements were the development of ductile tungsten and the wire-type tungsten lamp. The greater ruggedness of the tungsten lamp resulting from these two improvements have practically eliminated its former fragility. But in even those tungsten lamps in which these new features have not been employed, there have been improved methods of manufacture and shipment which have yielded a more durable and satisfactory product. This is shown by the good results obtained with multiple lamps in street lighting without the use of shock absorbers. These improvements in quality, along with the substantial reduction in price made early in the year and the greater number of sizes available, have certainly given the tungsten lamp even still greater prestige in the lighting field than it already enjoyed and accord

for it at least as extensive use as it has attained in Europe, where nearly fifty per cent of the incandescent lamps are of the metallic-filament type.

Arc lamps of the intensified pure carbon, the flaming carbon and the magnetite types have been improved and consequently more generally employed. The compactness, high efficiency and white color of the intensified arcs have brought about their extensive use in store lighting. The chief improvements in flaming-arc lamps have been in the direction of increased life per trim of electrodes, for which purpose the magazine principle, although quite frequently tried out, has not given the most desirable results, however. The vertical-carbon type of flame lamp has come into greater favor, largely due to its less concentrated light distribution. Flaming arcs have been much more generally used for lighting large areas, such as arenas, railroad trainsheds, foundries, etc.

Magnetite series arcs are now made in a greater number of current capacities and have been improved in details of construction so as to give still better results in street lighting where they have already been widely used. They are rapidly replacing the old open-arc series lamps with material improvement in street illumination. Multiple magnetite arcs were introduced during the year and have immediately become a formidable competitor of the inclosed carbon arc for the lighting of shops of large area.

Vapor-tube lamps, although not radically modified, are being more extensively used, and in some instances even intentionally for color effects. Announcement has been made of the development of a phosphorescent reflector for use with mercury-vapor lamps which will transform the reflected rays from a greenish to a reddish hue, thus making the resultant color of the lamp more suitable for general use; these reflectors have not yet been placed on the market. The mercury-vapor quartz-tube lamp, although not developed commercially in this country, gives promise, according to the reports from Europe, of becoming a very attractive light source, due to its extremely high efficiency and excellent color of light and compactness of construction.

The improvements in the electric light sources enumerated above, as well as those not mentioned, have still more strongly fortified the electric lighting industry in its gradual conquest over its competitors. At a recent meeting of illuminating engineers a representative of one of the largest gas companies in this country said it must be admitted that electricity has come to be preferred for the lighting of the largest and most important public and private buildings, and that gas is seldom considered for office buildings, hotels and the homes of the *elite*; this was due to the admitted lethargy of the gas interests and the great activity of the electrical interests, he said, but a change was imminent, for the gas men have become thoroughly aroused to their opportunities. That electrical men have nothing to fear, however, is evident from the year's developments already cited; in fact, the improvements in the tungsten lamp alone have placed in the hands of electrical companies a new weapon for making headway in a field not yet adequately electrified, namely, the supply of current for lighting and miscellaneous purposes to the extremely numerous small consumers in residences, stores, shops, etc. Lighting companies have realized that if they can get a sufficiently dense cluster of small consumers the supply of current to them becomes profitable. The use of the high-efficiency lamp has permitted great extensions of electric service on these lines during the past year.

Electric street lighting has also received marked advance through the employment of the new high-efficiency illuminants. Probably the most important development in this line has been the large number of installations of ornamental street lighting. Although all modern electric lamps have shared in this movement, the tungsten incandescents have easily led the way, with magnetite arcs in second place. The most popular form of ornamental tungsten lighting is with clusters of lamps on iron or concrete columns, although in some localities, notably in Michigan, tungsten arch lighting has come into considerable vogue. It is to be hoped that more of this decorative street lighting, which received such a great impetus by private initiative in the past year, will be undertaken by the public and in a methodical manner suitable to the character of the streets illuminated. In many instances modern arc lamps are to be preferred to tungsten clusters, and the present popularity of the latter should not prevent the choice of the most suitable lamp.

Akin to decorative street lighting is that of parks and boulevards, wherein again the tungsten lamp is receiving prominence and replacing gas and gasoline. The fact that the tungsten lamp may be hung below the prevailing foliage in parks and residence streets makes it peculiarly suitable where arc lamps would be out of place. For such service the series tungsten is giving exceptionally good results.

Sign lighting with low-voltage tungstens has given a new aspect to this form of electrical advertising. The brilliancy of the new signs, as compared with the old carbon-lamp signs, and the low operating cost have opened increased opportunities to the sign business. Outline and display lighting have also been made more generally possible by the use of this lamp. The possibilities for artistic treatment in this line have been shown by the splendid example in Denver, recently described in these columns.

Car lighting on electric railways is now being generally changed from carbon to tantalum lamps, the latter giving excellent satisfaction and increased economy. Train lighting on the steam railroads is being converted to low-voltage tungsten lamps, one large railroad having already adopted them exclusively for all new equipments in place of gas. Low-voltage tungstens are also coming into extensive use for automobile lighting and thus replacing the glaring and troublesome acetylene outfits.

For interior lighting there have been improvements not only in the illuminants themselves, as already pointed out, but in the variety of shades, reflectors and lighting fixtures in general. A hopeful sign of the times is the greater attention now given to the avoidance of glare, as shown by the more general use of diffusing glassware, the more scientific selection and placing of lamps, and the increased use of indirect systems of illumination. The latter have been developed to a high state of perfection and are becoming much more commonly used in public buildings as well as commercial structures. A modified form of indirect lighting, wherein the lamps are placed above a ceiling of clear or colored diffusing glass, has been used in several large interiors with most excel-

lent results and bids fair to find more extensive application where the architectural conditions permit. A truly wonderful installation of this sort in which active use was made of the color values in flaming-arc, nitrogen-tube, mercury-arc and tungsten lamps to produce some strikingly beautiful color effects, was completed in the Allegheny County Soldiers' Memorial at Pittsburg. This shows the remarkably varied artistic results that may be achieved by electric lighting and constitutes a masterpiece of illuminating engineering.

Space does not permit more than a brief mention of the year's progress in illuminating engineering. The most noteworthy features in this connection are the greater recognition that has been accorded to the principles of this science and art by the general public, the better appreciation of its great breadth of scope and wide ramification of interests, and the increased strength and more complete co-operation of those active in providing higher standards of illumination. Only two things need be cited to illustrate these points; the first is the phenomenal increase during the year of something like fifty per cent in membership in the Illuminating Engineering Society; the second is the remarkable series of lectures on illuminating engineering given during the fall at Johns Hopkins University under the joint auspices of the Illuminating Engineering Society and the University and attended by over 230 persons. The educational value of these lectures and the increased strength of the Society are bound to produce in the year 1911 a much better conception of the true principles of illuminating engineering and a much wider acceptance and application of them with material benefit to the eyesight of the human race.

Electric Railways.

It would be difficult to single out any particular achievement in the progress of electric traction development made during the past year, as the advancement has been general in all departments. However, while the past year has not been characterized by the large number and magnitude of its electric railway installations, some of those made are of special interest as giving indication of the development of the industry along new and broader lines. Taken altogether, it is conservative to state that the electric railway industry has made most important advances during the year just passed and is now entering into untrodden fields of great extent.

The electrification of steam road terminals in and about large cities has been given increasing attention. In New York the magnificent terminal station of the Pennsylvania was opened for regular traffic by electric trains of that extensive system. The engineering feats accomplished in driving the tunnels under Manhattan Island and the two rivers which flank it on either side and in erecting the monumental terminal station building have overshadowed in the public eye the electrical problems connected with the equipment of the tunnels for train operation. But if the art of heavy electric traction had not reached its present development the enterprise would have been doomed to failure at the start.

A new and powerful type of side-rod locomotive is used for hauling through trains. The decision of the Pennsylvania to adhere to the 600-volt third-rail system would indicate its general acceptance as a system possessing a number of advantages. The power generation and distribution system of this project do not differ in their essential details from other standard direct-current third-rail installations. As an example of terminal and suburban electric operation the Pennsylvania and Long Island suburban systems rank first among the electric railway undertakings so far completed.

The long awaited reports of the New York, New Haven & Hartford Railroad and the New York Central & Hudson River Railroad on the proposed electrification in the Boston metropolitan district was made public during the past year. An idea of the extent of the project involved is shown in the total figures of cost, which for the roads concerned, amount to over $40,000,000. Neither company is entirely opposed to the change to electric motive power, but each recommends its introduction gradually with subsequent extension as rapidly as may be consistant with the financial conditions and the public needs.

In Chicago the chaotic conditions which have obtained for the past few years are but little changed. That the public demands some definite action is shown by the appointment of a civic commission to investigate all phases of the question. The Chicago Association of Commerce, through a committee of prominent engineers, reported that electrification of Chicago terminals was entirely feasible from an engineering standpoint. To consider the financial aspect of the question a committee of city officials was appointed by the mayor to confer with the associations' committee. During the year, also, two more or less harmless ordinances were introduced in the City Council, but no other action has been taken.

Main line electrification continues to progress. The decision of the New Haven Railroad to adopt the single-phase system on the Hoosac Tunnel division and on its New York, Westchester & Boston line, announced during the year, is one of the most important developments. Practically no equipment has been subject to more adverse criticism and has been more stoutly defended than the present single-phase system on the main line of the New Haven road. The electrification of the Hoosac Tunnel and of the New York, Westchester & Boston line will practically be equal, both in importance and mileage, to that of the present electrified main line, and the electrification of the Harlem River branch and of the main line from Stamford to New Haven together will be practically equivalent to twice the present electrical system. This project indicates that the present system of the New Haven Railroad has been so satisfactory as to warrant its extensions. This road has also, during the past year, added a number of new single-phase, multiple-unit trains.

Single-phase operation has also been extended on the Spokane & Inland Empire, the Rock Island & Southern and the Chicago, Lake Shore & South Bend Railway. The latter road has had exceptionally good results with the operation of single-phase, multiple-

unit trains with unit-switch control. Eleven-car trains are handled at high speed without trouble.

The Baltimore & Ohio Railroad placed in service during the past year two new direct-current electric locomotives for its belt-line service. These are similar in design and appearance to the Detroit River electric locomotives. On other roads noticeable advancement has been made in the extension of direct-current systems.

In the interurban railway field 1,200-volt direct-current operation has been very successful. Roads report that the lower initial cost and substation expense is not offset by added operating expenses. During 1910, for the first time rotary converters were operated in series for generating current at 1,200 volts, both twenty-five and sixty cycles, with much success. Some of the notable 1,200-volt installations which were placed in operation during the year are the Milwaukee Electric Railway & Light Company, the Washington, Baltimore & Annapolis Railway and the Aroostock Valley Electric Railway.

Many interurban lines have extended their systems, added new equipment and provided better travelling facilities. A marked movement for a bid on freight haulage has been made by several roads which have installed heavy electric locomotives for this service. Prominent in this respect is the Galt, Preston & Hespeler Railway.

In the street-railway world the most important happening was the convention of the American Street and Interurban Railway Association at Atlantic City, at which time the name of the organization was changed to a more significant title. As usual a number of excellent papers were presented which indicate the advancement in this branch of electric traction. To the evidence of actual installation should be added these papers and discussions which, while largely describing apparatus already built and in operation, yet unfold to some extent the designs and plans under way for the present and immediate future. In this connection some mention should be made of the excellent paper by George Westinghouse, presented at a joint meeting of the American Society of Mechanical Engineers and the British Institution of Mechanical Engineers, in London. Mr. Westinghouse's paper dealt with railway electrification and will be considered a classic on this subject for many years.

The past year has seen a great increase in the number of pay-as-you-enter cars on the city lines and many modifications have appeared. Improved tracks, roadbeds, car houses, stations, etc., have also been constructed and installed, particularly in Chicago.

Gasoline-motor cars have been further developed to a certain extent, and the Southern Railway Company has installed two of them on its system after exhaustive tests.

The storage-battery car has undergone a number of changes and improvements, and during the year replaced an old horse-car line in New York city. This type of car has also been operated with apparent success on belt lines of steam railroads.

In California, a trackless trolley line has been placed in operation, near Los Angeles, for transporting passengers from a street-railway terminal to a resort. Reports indicate that the system is operating successfully.

In the field of railway material greater efforts towards standardization were made. The claim for the interpole motor for street railways seems to have been fully realized. Line material has also been improved to a great extent.

Electrochemistry and Batteries.

The electric furnace continues to receive the greatest attention from electrochemists. The principles of design are becoming better understood each year, and improvements are being made steadily. There is no general agreement as to the best type of steel furnace, but installations of various kinds continue to be made and the total number now in use exceeds 100; while their introduction in this country for making the best grades of steel is becoming general. The induction furnace has not been so largely used in this country as abroad. The three-phase type appears to have advantages over the single-phase, and its more extended use may be looked for.

The fixation of atmosphere nitrogen has made advances both from the commercial standpoint and as regards a knowledge of the process and of the best conditions of working. It has been shown that at a pressure of 200 atmospheres and a temperature no higher than 500 degrees centigrade, nitrogen and hydrogen will combine chemically in the presence of a catalytic agent. This purely chemical method has become a competitor with the electrical processes. In the more usual electric apparatus for this purpose it has been shown that the operation is partly thermal and partly electrical.

The manufacture of ozone is increasing and it is being widely used for ventilating purposes and for the purification of water. Yields have been obtained as high as 250 grams per kilowatt-hour, representing a volume concentration of 2 per cent. In this connection the use of the mercury-vapor lamp for the sterilization of water with ultra-violet light may be mentioned.

The extension of electrochemical methods in the manufacture of a great number of products continues and these developments are too numerous to mention in detail. Among them, however, the Whiting cell for the production of caustic alkali and chlorine from alkaline chlorides may be mentioned. It makes use of a mercury cathode.

The year has been unprecedented for the development of storage batteries. Several new types have entered the field and important improvements in others have been brought about. Perhaps the most prominent feature in this line is the advent of the Edison alkali battery in its improved form. This is being widely applied to electric vehicles and street cars, its advantage being greater in these particular fields on account of its low weight. It is stated to give over fifteen watt-hours per pound when operating at the normal rate, and the performance and life are said to be much superior to the first Edison battery.

Another alkali battery has been developed during the year by Morrison, and is about to be placed on the market. This battery consists of an elec-

trolyte of potassium hydrate, a positive plate consisting of an oxidized amalgam of copper and a negative plate of zinc chromite. Twenty-five watt-hours per pound is claimed for this battery. It is said to be almost indestructible and the limit to its life has not yet been ascertained. It does not deteriorate with use and cannot be heated sufficiently to injure it.

Among the lead batteries considerable improvements are to be introduced. The well known Exide battery has been improved and a new form known as the Iron-clad Exide is just being put upon the market. The advantages claimed for it are increased capacity per charge, much longer life and no necessity for cleaning. The Salom battery, which has been brought out during the year, makes a radical departure in the method of manufacture. In this battery the active materials are produced chemically and are then incorporated under enormous hydraulic pressure with a grid to form the active plates, which then require no forming. This battery has about the same capacity as older types of lead battery, but it is claimed to be much more durable and to retain its capacity better owing to the freedom from shrinkage of the active material. There is no disintegration of the plate and consequently no necessity to clean sludge from the bottom of the cells.

Another new lead battery is the Hirsch portable battery in which there are but two plates per cell which are placed horizontally.

A new form of mercury rectifier for charging vehicle batteries has been brought out and in England an electromagnetic rectifier has been put into service for which an efficiency of 90 per cent is claimed. It utilizes both halves of the wave.

Attention is being given to the proper methods of testing dry cells with the result that it is possible to choose such cells with greater consideration of their appropriateness for the use intended. A new primary cell has been brought out in England, known as the Bleeck-Love. It is a two-fluid cell with an electromotive force of 2.7 volts, large current capacity, and constant voltage.

Prime Movers.

It has been estimated only a fraction of one per cent of the electrical energy in use today is derived directly from the chemical energy of primary batteries. This shows the importance of prime movers in the generation of electricity. Their development is practically of as much interest to electrical engineers as that of the generators which they drive.

The most marked development in prime movers during the past year has been increase in capacity in nearly all types. This has been made necessary by the stupendous growth of the central-station business. As the demand on an electric supply station increases it becomes economically imperative to use larger generating units. If more powerful units were not available the capital investment in the generating plant would become prohibitive and the industry seriously curtailed. But engine and turbine builders have been equal to the occasion and have readily met the demand for more powerful prime movers. The capacity has now risen to 20,000-kilowatt machines and the end is not yet in sight. Predictions of 25,000-kilowatt units are already heard. Although marine engines long held the honor for size, prime movers for electrical purposes have for several years easily taken the lead and never to surrender it until mechanical energy will no longer be needed in the generation of electricity.

In reciprocating steam engines there have been for some time no marked developments, although they continue to hold their own in smaller stations, such as isolated plants and those for the generation of direct current. It is also likely that they will be preferred for stations using exhaust steam for district-heating systems, because turbines give their best results when operated as condensing units.

Steam turbines have received an enormous impetus during the past year both in extent of use and in capacity. The compactness of a turbo-generator unit makes it peculiarly suitable for increasing the capacity of an existing plant without enlarging the building. New plants are built with a minimum of capital investment. As a result the steam turbine is found in a surprisingly large number of plants, the horizontal-shaft turbine being generally preferred except for the largest machines. Although the largest machines actually in use have a continuous rating of 14,000 kilowatts, there are now under construction five turbo-generating units of 20,000-kilowatts capacity each at similar rating. This is surely a tremendous advance in the last decade, for in 1900 there were but few steam turbines in use.

Exhaust-steam turbines are also growing in favor, particularly as a means of increasing the capacity of existing engine plants without material increase in the boiler equipment. They have been installed in a large number of plants at minimum expense, with trifling interference in operation of the existing units, and with marked increase in the station capacity. A few new plants have been constructed where they have even been installed right from the start as auxiliaries to engines driving direct-current generators.

The great attention directed to the development of water power has taxed the resources of water-wheel builders in keeping up with the demand for hydraulic machinery of all types, both as to number and size of units and as to perfection of design so as to secure closer regulation and higher efficiency. American builders are now turning out hydraulic turbines fully equal in design and operation to the foreign makes. The capacity of these machines has been raised to over 20,000 horsepower and the governor mechanism has been materially improved. Further advances are to be expected, because the call for these prime movers is bound to increase with the exploitation of the water-power resources of the country.

Gas engines have been improved in many details of construction which have made them more rugged and serviceable machines. Larger engines are now also available, but scarcely of a size that would make them active competitors as the prime movers of our large central stations. The great number of units that would be required in such a plant would necessitate a capi-

tal outlay far in excess of what is needed for a steam turbine installation and the increased fixed charges and greater labor costs would overbalance the saving from higher efficiency. In small plants, however, the conditions have generally been found the reverse and numerous installations of gas engines and gas producers have consequently been made with highly satisfactory results in such plants. An exception to this generalization is found in the great extension of gas engines for driving electric generators in iron and steel mills. One of these power houses is nearly a fourth of a mile long, with some thirty-five gas-engine generating sets. As the blast-furnace gas used for fuel is in these plants a by-product, the operating costs are extremely low and make up for the excess of the fixed charges.

The gasoline engine, although not a formidable prime mover for electric plants, deserves notice for the improved form in which it has been arranged for driving generators for farmers' use, and in small isolated plants remote from the lines of any electrical supply company. Such equipments are of value, despite their shortcomings, because they popularize the use of electricity and pave the way for the power company when it extends its lines. Wind power has also been utilized in such isolated locations, but much remains to be done in simple voltage regulation at variable speed and in economical storage batteries before wind power will attain the prominence that its possibilities seem to point out for the future.

General Survey and Manufacturing Statistics.

In electrical machinery the tendency is for cheaper design, standard parts and higher temperature rise. Synchronous motors are displacing in some places induction motors in the larger sizes. Interpoles are becoming more and more popular, three-phase traction is receiving consideration, single-phase traction is becoming quite popular abroad and the three-phase commutator motor opens up a promising field for industrial applications.

It is being discovered that high speed is not necessarily an index of economical design from the standpoint of first cost and recent studies in connection with the design of fairly large turbo-generators operating at about 3,600 revolutions and generating sixty-cycle current indicate that it would cost practically as much for a machine for the same output operating at 100 revolutions per minute.

In turbo-generators the tendency is to improve the ventilation and increase the efficiency of the fans, and thereby reduce the loss and resultant temperature rise due to great windage loss. The demand for high-voltage generators has resulted in more careful proportioning of the insulation and it has been found that the same principles which have been applied to cables can be adopted to advantage in the case of the slot insulation of high-voltage generators.

The grading of the insulation enables the designer to use a smaller quantity and he can thus place more copper in the same size slot than would be the case were all the insulation of the same material. It also has the additional advantage that with the thinner insulation the heat can flow more rapidly from the conductor to the outside of the coil.

The design of induction motors has been greatly influenced by the more perfect theoretical understanding of leakage in this type of machine. This has produced a decrease in the weight of the active material of the motor, which will make it still more imperative in the future that motors be cooled by forced ventilation. An interesting development in the induction motor is a line of small and moderate sized four-speed machines, for constant horsepower and variable horsepower proportional to speed of constant torque. The constant power motors are intended largely for machine tool work, while the constant torque motors have a varied application. Induction motors have been developed for channeling machines, due to the fact that the ordinary motor will not stand the heavy vibration and severe rocking incidental to this service. Another development is a vertical motor for driving grinders in a cement mill, the bearings being designed to be practically dust and grit proof. The Indiana Steel Company has installed two 6,000-horsepower induction motors and one 6,500-horse-power machine. These induction motors for use in steel mills are being called for to a considerable extent, although it seems to be a tendency among quite a few engineers connected with these plants to abandon the use of alternating current in connection with small motors and to use motor-generator sets and direct current machines for the smaller services. The induction motor has also entered very successfully into pumping, well-drilling, sanding and baling in the oil fields and several very interesting installations have recently been made at the Coalinga and Bakersfield districts in California.

The single-phase commutator motor is constantly gaining in importance, and has proved successful in various services. Series-wound railroad motors are operating satisfactorily on a number of roads and the repulsion motor has also gained some ground.

In addition to the invasion of this single-phase apparatus into the railway field it is making new converts every day for the operation of elevators, printing presses, blowers and similar machinery.

With respect to electrical machinery it might be well to call attention to some features connected with the design of immediately auxiliary apparatus. A new line of lighting transformers in capacities of fifty kilovolt-amperes and below has been developed. In these the primary connection board is so designed as to render improper connection practically impossible. The connection boards are submerged under oil and the proper height of the oil is plainly indicated on the inside of the tank. Large sturdy bushings are brought out at a short angle carrying the leads well away from the tank. These transformers are now being built for transmission potentials as high as 80,000 volts. In the larger type station transformers larger units than heretofore have been brought out, the largest built being three-phase, twenty-five cycles, 10,000 kilovolt-amperes, and single-phase, sixty-cycles,

6,000 kilovolt-amperes. The general Electric Company is now under contract to furnish a number of three-phase, 100,000-volt, 14,000-kilovolt-ampere transformers. On some of the larger units transmission voltages have been used as high as 138,500. Leads for these transformers have been tested at 330,000 volts with an entire absence of corona. Some interesting combined transformers and voltage regulators

Development of heating apparatus has been making big strides and equipment of all kinds is being designed with closer reference to scientific principles. Many new appliances have been put on the market and are giving good results. In one make of apparatus the resistors are hermetically sealed within welded metal jackets. A water heating attachment for pipe systems has been introduced in which the heating elements

improved so as to require less power in operation. The construction of rheostats has been improved in details and automatically controlled field-rheostats have been made.

An important development has been the extension of electrical applications in shipyards and on shipboard, electric power now being used for almost every conceivable purpose. In the printing-press field the tendency is towards mag-

ESTIMATE OF THE VALUE OF ELECTRICAL AND AUXILIARY MANUFACTURES IN THE UNITED STATES.

Articles.	For the Year— 1906.	1907.	1908.	1909.	1910.
Arc lamps and appurtenances	$ 3,225,000	$ 3,150,000	$ 2,000,000	$ 2,500,000	$
Auxiliary steam plant for electrical installations, such as pumps, condensers, separators, feed water heaters, injectors, piping, etc	3,275,000	3,100,000	2,000,000	3,000,000	
Bells, buzzers, push-buttons, call-boxes, annunciators	1,250,000	1,300,000	1,300,000	1,500,000	2,000,000
Belting used in electrical plants	450,000	425,000	200,000	200,000	200,000
Boilers for electrical plants (water-tube)	7,500,000	6,000,000	4,000,000	5,000,000	
Boilers for electrical plants (other than water-tube)	2,750,000	2,500,000	1,500,000	1,750,000	
Cables, underground, aerial and submarine	22,000,000	18,000,000	10,000,000	11,000,000	
Carbons for lamps, batteries, brushes or other electrical purposes	3,500,000	3,500,000	2,250,000	4,000,000	4,500,000
Cars and trucks for electric railways	11,750,000	8,650,000	6,900,000	7,500,000	
Castings, copper, and other metals, used by electrical manufacturers	.....	.....	300,000	500,000	600,000
Circuit-breakers	1,700,000	1,675,000	920,000	1,200,000	1,350,000
Conduits (underground) and similar material	2,900,000	1,700,000	500,000	700,000	850,000
Conveyors, coal and ash, used in electrical plants	900,000	775,000	400,000	425,000	500,000
Cranes and hoists, electrically operated	6,750,000	5,850,000	3,500,000	4,500,000	6,000,000
Dynamos and motors, including parts of machines, boosters, balancers, rotary converters, motor generators, etc., and all motor applications, such as in automobiles, not specifically enumerated in this list	74,000,000	62,500,000	50,000,000	70,000,000	
Electroplating and other electrolytic apparatus not elsewhere specified	1,000,000	1,000,000	1,000,000	1,100,000	1,000,000
Electrostatic machines, induction coils, medical sets, etc	550,000	500,000	500,000	600,000	750,000
Elevators, electric (mechanism only)	5,500,000	4,675,000	1,600,000	2,000,000	2,600,000
Engines, gas, gasoline or oil, used to drive electrical machinery	3,500,000	4,300,000	6,000,000	9,000,000	
Engines, steam (reciprocating), used to drive electrical machinery	13,500,000	12,000,000	9,000,000	12,000,000	
Fans, electrically operated and direct-connected	1,575,000	1,850,000	1,100,000	1,500,000	2,000,000
Firm-alarm apparatus, also burglar alarms, crossing indicators, etc	1,850,000	1,850,000	900,000	1,000,000	800,000
Fixtures for electric lighting	5,300,000	7,500,000	8,000,000	10,000,000	11,000,000
Fuses	900,000	1,200,000	750,000	1,000,000	1,150,000
Glassware, electrical	900,000	1,450,000	2,000,000	2,500,000	3,000,000
Heating and cooking apparatus, electrical	850,000	1,100,000	1,000,000	1,500,000	2,000,000
Incandescent lamps (carbon or metallic filaments)	8,600,000	10,000,000	11,000,000	14,000,000	
Instruments for measurement and meters of all kinds; also ground detectors, scientific and laboratory apparatus, photometers, Leyden jars, X-ray outfits, etc	5,000,000	5,000,000	2,000,000	2,250,000	2,400,000
Insulating material, fiber, tape, etc	2,300,000	2,850,000	1,700,000	2,500,000	2,700,000
Insulators (glass and porcelain)	2,100,000	2,000,000	1,350,000	2,300,000	2,560,000
Interior wiring supplies, as tubing, interior conduit, molding, junction boxes, rosettes, outlet boxes, etc	3,000,000	3,500,000	2,220,000	3,000,000	2,500,000
Lightning arresters	525,000	500,000	275,000	400,000	500,000
Mercury-vapor lamps	350,000	450,000	300,000	500,000	
Nernst lamps	950,000	950,000	1,000,000	1,000,000	
Poles and wire towers, cross-arms, brackets and pins	7,500,000	5,125,000	3,500,000	4,000,000	
Primary batteries	1,825,000	1,800,000	1,000,000	2,000,000	
Railway supplies, electric, such as trolleys and other contact devices, strain insulators, cross-overs, rail-bonds, etc	3,000,000	4,000,000	2,200,000	3,000,000	
Rheostats, car controllers, motor starters, etc	4,600,000	4,750,000	2,600,000	4,700,000	5,000,000
Shafting, pulleys, clutches, etc., used in electrical generating plants	800,000	725,000	400,000	500,000	500,000
Signs, electric	.....	.....	1,000,000	1,250,000	1,500,000
Sockets, switches, cutouts	5,500,000	5,500,000	4,000,000	5,000,000	6,000,000
Steam turbines used to drive electrical machinery	8,000,000	8,000,000	7,000,000	12,000,000	
Storage batteries, including those used in automobiles	6,950,000	6,200,000	5,500,000	6,600,000	
Telegraph instruments and apparatus	375,000	475,000	400,000	600,000	500,000
Telephones, telephone switchboards and distinctively telephonic apparatus	28,500,000	21,000,000	15,000,000	15,000,000	
Third rail for electric railways	950,000	750,000	.....	1,000,000	
Transformers, stationary	6,850,000	5,500,000	2,025,000	4,000,000	
Waterwheels, used to drive electrical machinery	2,750,000	3,100,000	3,000,000	4,000,000	
Welding apparatus, electric	110,000	120,000	.....	150,000	200,000
Wire, bare	33,000,000	27,000,000	18,000,000	22,000,000	
Wire, rubber-covered	14,000,000	16,500,000	11,000,000	12,000,000	
Wire, weatherproof	15,000,000	15,000,000	9,000,000	10,000,000	
Wire, all other electrical	4,625,000	4,150,000	4,000,000	5,000,000	
Wireless apparatus	475,000	425,000	500,000	500,000	350,000
Miscellaneous, including switchboard frames and panels, signs and flashers, automatic stokers for electrical plants, wire guards, electrical tools and toys, projectors, solenoids, igniters for gas engines, waterwheel governors for hydroelectric plants, voltage regulators, electric drills, commutator compounds, lamp adjusters, shade holders, etc	6,000,000	4,000,000	.....	10,000,000	10,000,000
Total	$351,010,000	$315,920,000	$228,590,000	$304,225,000	$338,060,000

have been built for the International Acheson Graphite Company, designed for use with resistance furnaces where it was necessary to handle 50,000 amperes, and vary the potential from 40 to 160 volts. A number of transformers for testing porcelain insulators have been built for potentials as high as 400,000 volts, and the General Electric Company is now building a 750,000-volt transformer for this purpose.

consist of carbon rods whose circuit is closed when water is admitted to the cylinder.

The tendency in switchboard work has been towards standardization, reliability and simplification. Larger capacities and increased voltages can now be taken care of by switching apparatus. The use of remote-control apparatus both for switchboards and for rheostats is increasing. Relays have been

netically operated controls which allow for many refinements not possible with the manually operated controller. The construction of lifting magnets has undergone several changes, among which may be mentioned the development of a water-proof magnet.

Electrolytic lighting arresters have given good service in station work and may be said to have become standard. The use of Nicholson guard rings

around insulators has also met with great success. Improved types of pole insulators and pole switches have been developed. A new insulating material known as "protal" has been invented and a combination of this with bakelite promises to take an important position in the industry. This material can be pressed, molded and polished, is acid- and water-proof and has a dielectric strength of from 10,000 to 26,000 volts per millimeter. Important work upon the investigation of dielectric strength has been done, among which may be mentioned the papers of Whitehead, and of Steinmetz and Hayden. The design of insulation in general has received much attention, particularly with reference to the use of different materials in layers in order to properly distribute the electric stress.

Improvements have been made in the apparatus for photo-telegraphy and the electric properties of selenium have been further studied. A type of selenium whose conductivity decreases upon exposure to the light has been discovered by F. C. Brown.

In the field of instruments many slight improvements are to be noted, involving permanency of accuracy, standardization of design and the increased use of manganin shunts. The Brooks deflection potentiometer has been made in commercial form and in England the Drysdale potentiometer for alternating currents has been brought out. The work of the International Committee at Washington has resulted in an international agreement as to the specifications for constructing the standard cell and for the operation of the silver coulometer, and the national standardizing laboratories of the world have agreed upon a value of 1.01830 volts for the saturated Weston cell at 20 degrees centigrade. The Bureau of Standards is now changing its unit of voltage and of current to this basis, which puts it in agreement with the units of the European countries. Since each of these units has been made larger, the watt, which is defined by their product, is doubly increased and its value is now 0.16 per cent larger than in the past.

The work of Dellinger upon the conductivity of copper and its temperature coefficient, announced last spring, is an important advance.

In the field of electrotherapeutics attention should be called to the application in this country of Leduc's method for anaesthesia by electricity. For this purpose a current interrupted at the rate of 20,000 times per minute is applied to the nerve controlling the affected part. The application of high-frequency currents has also been made to the coagulation of the albumen in the blood and tissues, thus permitting surgical operations without shedding of blood.

Attention may also be called to the work of the non-magnetic yacht *Carnegie*, which is continuing the magnetic survey of the Atlantic Ocean and increasing our knowledge of the distribution of the earth's magnetism.

In the table on the previous page are given figures estimating the approximate value of the manufactures of electrical and kindred apparatus turned out during the past year. These figures have been compiled from data supplied by the leading manufacturers and engineers interested in these products, and we take this opportunity of thanking very cordially those who have cooperated with us in the development of these statistics.

Recapitulating into several groups the figures given in this table we are able to present in the following brief summary the comparative value of the electrical output during the past two years:

	1909.	1910.
Wires and cables	$ 60,000,000	$ 68,500,000
Dynamos and motors	70,000,000	75,000,000
Prime movers	33,000,000	38,500,000
Telephone apparatus	15,000,000	20,000,000
Lamps of all kinds	16,500,000	21,700,000
Cars and trucks and railway supplies	11,400,000	9,250,000
Boilers and auxiliary steam plant	9,750,000	11,350,000
Batteries, primary and secondary	8,600,000	9,250,000
Poles, etc	4,000,000	5,000,000
All other	75,975,000	79,510,000
Total	$304,225,000	$338,060,000

Tungsten Production in 1910.

The production during 1910 of 1,824 short tons of tungsten concentrates is believed to be the largest annual output made by this or any other country up to date, although the total value of the product falls below the figure of 1907. The value of last year's output was $832,992, while that of three years ago was $890,048.

Nearly all the tungsten is produced from fields in Colorado and California, and in the former state the Boulder field, which is the greatest producer, is situated. The second largest field is the Atolia field in California. Arizona, Washington and Nevada also contribute to the output.

ELECTRIC VEHICLES RIVAL GASOLINE CARS.

BY HARRY WILKIN PERRY.

Because there is little that is spectacular in the exploitation and use of electric passenger carriages the public is not inclined to follow the steady development and improvement in this field as in that of the gasoline cars, which are kept constantly before public attention by race meets, hill climbs, reliability runs, tours, and so forth. It seems to be the general impression, too, that there is little of mechanical interest in the construction of electric vehicles; that there is simply a battery and a motor, which the user is not expected to know much about or bother with himself, and a controller handle to push when he wants to set the vehicle going; the rest is merely carriage construction adapted to motor service.

To a large extent this impression and the apathy resulting from it are due to the policy heretofore maintained by the manufacturers of electric vehicles themselves, who have sought to create the impression that the user really need not know anything about electricity and mechanics in order to run and take care of an electric carriage. They have looked on at the many troubles that have beset the user of gasoline cars and rejoiced in the freedom from such annoyances enjoyed by purchasers of the carriages which they built, forgetting, no doubt, that it is one of the paradoxes of human nature to love best that which or the one who gives the most trouble, and that man takes greatest interest in the thing that is most mystifying and calls for the deepest investigation and thought to understand thoroughly. If everybody could have skated on rollers, or ridden a bicycle or driven a golf ball proficiently at the first trial it is safe to assume that no such great waves of enthusiasm for these sports would have swept the country, and if there were nothing mysterious and difficult about the aeroplane and its operation much less would be read about flying machines in the public press.

With the electric motor and controller brought to a state of practical commercial perfection in street-railway service and a storage battery that

had already given satisfactory service as a portable vessel for the absorption and gradual discharge of electrical energy, it was a comparatively simple task to build these units in sizes suitable for road vehicles and to assemble them on a running gear in such manner that they would be operative. The problem was greatly simplified by the fluid nature of electricity and the ease and safety with which it could be conducted through flexible wires around all sorts of bends without loss and the easy controllability of the volume of flow, rendering mechanical change-speed mechanism unnecessary. Hence, even the earliest electrics would usually run and were fairly dependable. Their chief drawbacks were excessive weight, low mileage per battery charge, bad designing and the use of poor materials which resulted in breakages.

Since the first electric vehicles appeared, however, there has been a steady improvement in every detail of the design and construction, including the electrical equipment, until today the electric vehicle is the most reliable, cleanest, quietest, most easily operated and most elegant and luxurious self-propelled road vehicle in use. The efficiency of batteries has been increased and the weight reduced, the motors lightened and made more efficient and reliable, and improvements made in the running gear, and especially in the methods of suspending the motor and transmitting the power to the road wheels, until now it is possible to run 100 miles or more on a single battery charge with some electrics, to drive at speeds up to and exceeding twenty miles an hour, to climb all ordinary hills and to make long trips, as from Chicago to New York, or New York to Boston, finding facilities all along the way for recharging the battery when necessary.

Such trips have been made by way of demonstrating the ability of the modern electric vehicle and, indeed, some of the latest models of electric runabouts are such near imitations of gasoline cars in outward appearance that it would take an expert to distinguish them on the street. However, it is recognized alike by the manufacturer and user that the electric vehicle has its definite limitations and that it is essentially adapted to town use, where the distances to be covered are not great, where the streets are paved and where there are charging facilities in the garage in which it is stored. It is particularly adapted to use for shopping, calling, attending receptions and other social functions and for going to the opera and theater, as it lends itself admirably to the prevailing styles in fine carriages, such as the coupé, brougham, landaulet, opera 'bus, victoria, stanhope, phaeton and runabout. It is a particularly good winter vehicle, because the closed types of bodies can readily be arranged for inside operation, affording the person who drives it complete protection from the weather. It is also an ideal machine for women to drive, as it is clean and safe and the manipulation of steering lever and controller makes no excessive demands upon the physical strength. For these various reasons it is becoming more and more the custom for men who own gasoline touring cars, high-powered runabouts and limousines to add one or more electric carriages to their garages for town service and for the use of the women of the household.

Most of the leading vehicle-battery manufacturers have brought out within the last year or two so-called high-capacity batteries having a considerably greater amperage than the regular batteries, so that it is possible to run a vehicle from twenty to twenty-five per cent farther at the same speed than with the older types of batteries. The new batteries contain a larger number of thinner plates than are used in regular batteries in jars of practically the same size and weight. For example, one leading make of thin-plate battery discharges 64.5 amperes at a five-hour rate while the medium thick-plate battery with jars of similar size discharges seventy amperes at the four-hour rate, a difference of 42.5 ampere-hours.

The nickel-iron battery has also been perfected and is now available for use in any make of electric vehicle. It has a decidedly high efficiency, being very light in proportion to its capacity; it deteriorates very slowly and is extremely clean and easy to take care of. All that is necessary, aside from recharging which is required by all batteries, is to keep jars filled with pure water and to give the outside of the jars an occasional cleaning. A nickel-iron alkaline battery will run a vehicle nearly twice as far as a lead battery of the same weight.

The introduction of improved batteries and high-grade steels, the reduction of weight of driving motors and increase of their efficiency by the use of ball bearings on their armature shafts, and the use of a single motor instead of twin motors have combined to make it possible for all electric-carriage manufacturers to cut down the weight of their vehicles very materially during the last two or three years, until now they compare very favorably in this respect with gasoline cars of the same styles. This reduction of dead weight relieves the battery of some of its work and the use of anti-friction ball or roller bearings throughout the transmission system and in the wheels still further relieve the battery, enabling it to drive the vehicle both faster and farther than formerly.

Not only in these invisible points but in general outward appearance also and especially in mechanical operation the electric vehicle has undergone a transformation. Gear drive from the motor shaft to the rear wheels was universally abandoned when the change was made from double to single motors, and now the standard form of final drive is by two roller side chains from a countershaft to sprockets on the rear wheels. The countershaft carries a differential gear, as in chain-driven gasoline cars, but the transmission from the motor to the countershaft is by broad silent chain running over spur gears. All operative parts are incased and run in oil so that they are practically noiseless and wear is reduced to the minimum.

Among the very latest and most important improvements in electric vehicles, however, is the introduction of shaft drive as in the majority of up-to-date gasoline cars. This construction is worked out in several different ways, but in each it avoids the use of exposed driving chains, and it seems probable that the idea will be adopted quite generally by the builders in this year's models and in those of subsequent years.

The average automobile user seldom exceeds thirty miles an hour or 150 miles a day in the ordinary use of his car, even when he possesses a gasoline machine with greater capabilities, so the electric vehicle would serve his purposes equally well. At the same time, the electric is much easier to take care of and less expensive to operate and maintain.

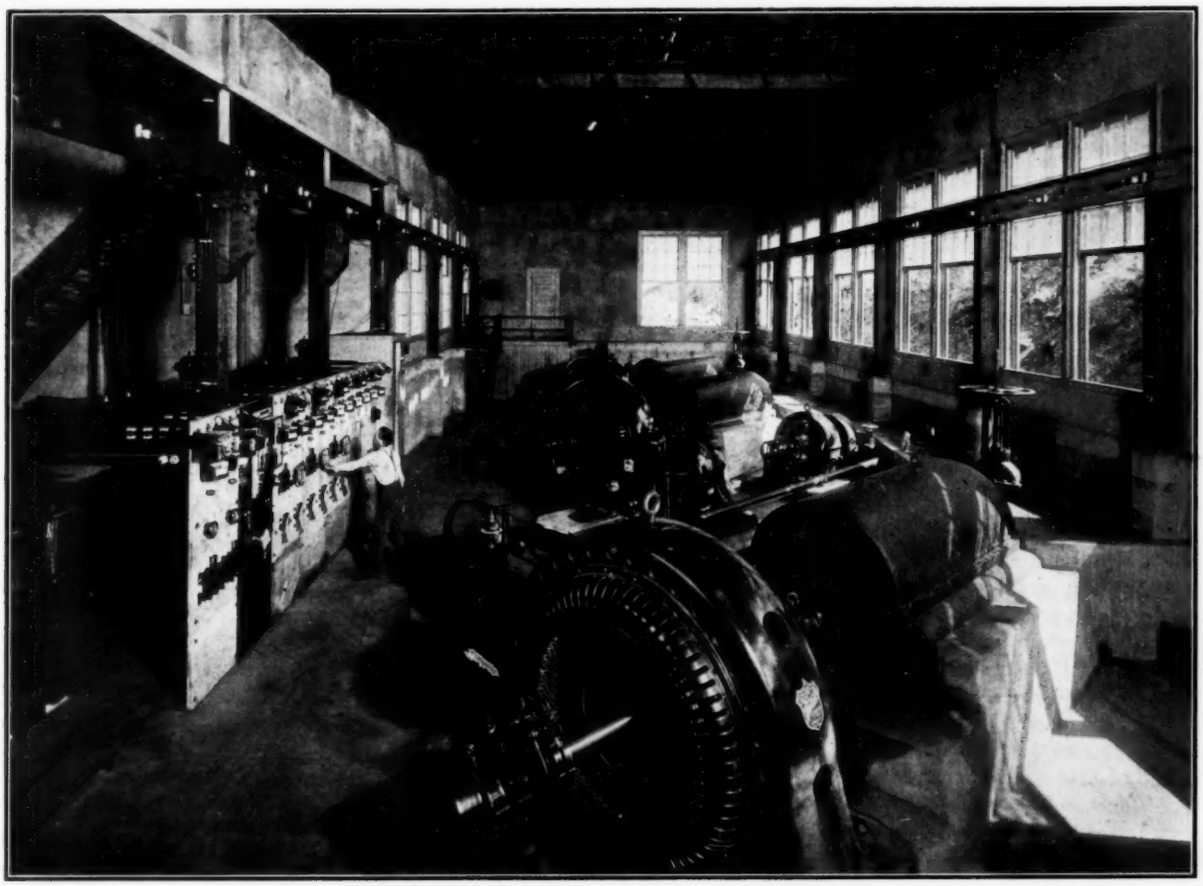
EXTENSIVE IMPROVEMENTS AT WALLA WALLA, WASH.

BY W. B. FOSHAY.

The Pacific Power & Light Company, which operates the plants at North Yakima and Walla Walla, Wash., and has a power transmission line from North Yakima to Pasco, has just about completed the erection of a sixty-foot pole line between Walla Walla and Pasco, thus tying in the two properties, so that service can be furnished from either point. This line is built for 66,000 volts, and there is a crossing at the Snake River, near Burkank, with a span of about 1,800 feet. This is made from towers, about 135 feet high. At Pasco will be located a switching station.

A new addition, forty feet square, has been added to the substation at Walla Walla, in which are being installed four new 1,000-kilowatt, General Electric transformers, together with lightning arresters and switchboard. This station also contains three transformers of 750-kilowatt capacity, used on the 25,000-volt line from the water-power plant of the company, situated on the South Fork of the Walla Walla River in Oregon, about fifteen miles from the city of Walla Walla. From this same plant there is a line to Freewater, Athena, Weston and Pendleton, Ore., which is operated at 25,000 volts. Regulators will be installed at the substation in Walla Walla, and many miles of pole

HYDROELECTRIC PLANT ON THE WALLA WALLA RIVER.



GENERAL VIEW OF WALLA WALLA RIVER PLANT.

lines will be changed and rebuilt, in order to better serve the city.

Walla Walla is noted for its beautiful trees, but from the standpoint of a central-station operator, this is not to be considered as anything to be glad about. For this reason, it is necessary to raise the height of many of the leads, and some $20,000 will be spent this coming year in this work. The company has opened up much new business, and during the coming year will install many new lines in and about the city for lighting and irrigating pumping.

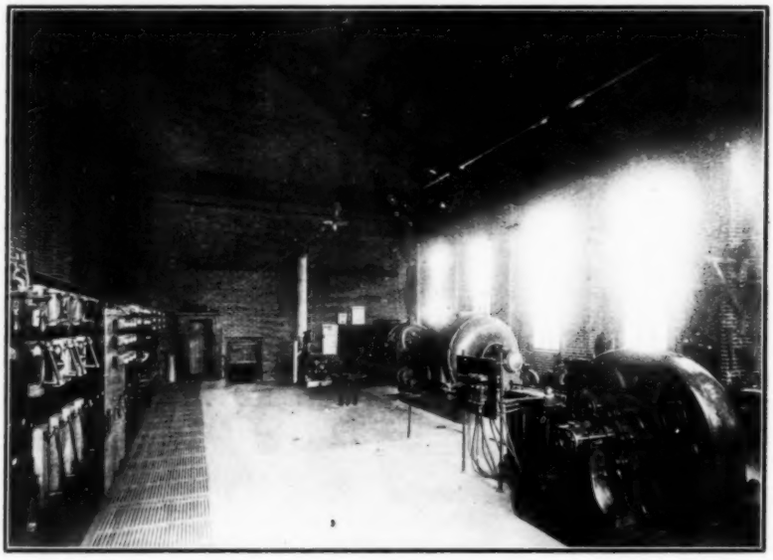
The substation is of brick, and is a very handsome structure. It is entered from the front, through large doors, of such dimensions as to allow any of the equipment to be easily brought into the station. On each side are the transformer cells, nine feet square, fitted with iron drop curtains, and ventilators above. There are four cells on each side. On one side will be installed the four 1,000-kilowatt 66,000-volt transformers. On the other side three 750-kilowatt 25,000-volt transformers, and in the fourth cell on this side, three 150-kilowatt 25,000/430-volt transformers for operating a rotary for street-railway service.

The high-tension leads will enter on the roof for the 66,000-volt lines, and on the side for the 25,000-volt lines, coming down into transformer cells. The 2,300-volt leads will be taken through to the busses in basement and into the switchboard, which is located in the old portion of the building, which was put up about eighteen months ago. This is directly back of the transformer building, and the front wall of the old substation forms the partition between transformer room and engine room, in which is the switchboard. Besides a fifteen-panel board, there is a 300-kilowatt railway rotary and an Allis-Chalmers turbine of 1,000 kilowatt capacity. In the basement are located the auxiliaries and condenser, which is a Wheeler jet condenser of the horizontal type.

Back of this engine room, which is 80 by 40 feet, is located the boiler room, which is about 40 by 50 feet and contains two 500-horsepower boilers, also heater and feed-water pump.

This steam plant is used as an auxiliary to the hydroelectric plant located on the Walla Walla River. Some five miles above the plant there is located a 40-foot diverting dam, from which the water is taken through an open flume for some 1,600 feet, and in this flume are located grates to prevent leaves and rubbish from being carried into the closed barrel flume. There is some five miles of this 48-inch barrel flume, constructed of staves and encircled with one-half inch bands, about eighteen inches apart. There is the usual forebay and penstock at the inlet to the descending flume at plant. This plant is operated at a head of 354 feet. The powerhouse contains one 500-horsepower Pelton impluse wheel, and three 1,000-horsepower Francis-Pelton turbines. Direct-connected to the impluse wheel and to two of the turbines, are three 500-kilowatt Bullock generators. These are operated at 600 revolutions per minute. There are two turbine-driven exciters. A new 1,250-kilowatt generator is under construction by the General Electric Company, and will be delivered in a few weeks for installation on the extra Francis-Pelton turbine.

VIEW OF BARREL FLUME, WALLA WALLA RIVER PLANT.

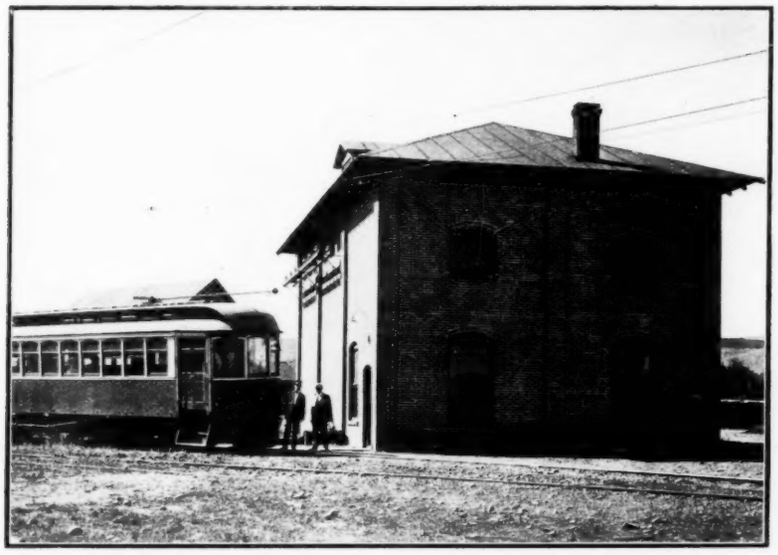


INTERIOR OF WALLA WALLA SUBSTATION.

There is an eight-panel switchboard, fully equipped, including a Tirrill regu-

lator. There are three transformer cells, each containing three 750-kilowatt transformers. Three of these have just been installed, to give capacity for the new generator to be installed. Directly over these transformers is located the switching room, from which the 25,000-volt lines leave the plant. There are twelve switches in this room, on the four lines, two of which lead to Walla Walla and two to the Oregon cities supplied. Here are also located the transformer switches.

At Freewater there is a substation containing transformer for lighting and power service, also transformers and rotary for the interurban railway. At Athena is located a substation for lighting and power service, from which the cities of Athena and Weston are supplied. Another substation is located at Pendleton for supplying power and lights to that city.



SUBSTATION OF PACIFIC POWER & LIGHT COMPANY, AT FREEWATER.

Walla Walla can receive power from either the 25,000 or 66,000-volt lines, and handle it through its transformers and feed in or out on any of the lines as desired. Thus a very flexible condition of operating is possible.

A Fine Incentive to Community of Interest.

The Detroit *Times*, of Wednesday, December 21, prints the following interesting editorial:

"A few days ago in this column we called attention to the signs of promise of a better and satisfactory relation between the boss and the hired man, or between capital and labor, in the disposition of the National Manufacturers' Association to meet the issue of employers' liability fairly.

"There has just come to our notice further evidence that the man who owns the whistle and the employe who responds to it are getting together—that the great barrier that has long stood between these two is fast coming down.

"Here is the latest evidence:

Christmas Notice to Our Employes.

This company desires to express, in a substantial way, its appreciation of the efforts of its employes; especially to those who have been in its continuous employ for a long time.

On Saturday, December 24, immediately after quitting time, each employe will please call at the office.

To such employes as are paid by the hour, who have been in continuous employ of the company for one full year, or over, previous to December 1, 1910, will be paid a bonus, in cash, amounting to two per cent of all the wages paid them during the entire term of their continuous employment with the company.

To such hourly rate employes as have been with us continuously since July 1, 1910, a similar bonus of one per cent will be paid.

To all employes, not stockholders in the company, who are paid by the month (and who therefore are paid during sickness and are given vacation periods with full pay), and who have been in continuous employ since July 1, 1910, a cash bonus of one per cent of all the salaries paid them during the term of their continuous employment will be paid.

In cases where absence has been due to sickness or to temporary layoffs, the employes will be considered as having been in continuous employment; but where a present employe has left our employ for any other cause, such employe will be considered as a new hand, and the bonus will be based on wages or salary paid since last re-entering our employ.

While this company cannot obligate itself to carry out this liberal policy in future years, it is hoped that conditions may permit of a continuance from year to year.

It is hoped that this policy will tend towards making our force more permanent, and that it will induce employes to hesitate before leaving us for trivial or unconsidered causes, as the bonus received by some of our older employes will amount to very substantial sums, which will indicate the advantage of continuous employment.

DETROIT INSULATED WIRE COMPANY
(Signed) F. F. KELLER, President.
December 17, 1910.

"The striking feature of this Christmas notice by the company is its admission in the closing paragraph that its motive is not altogether philanthropic.

"A working organization is nothing more nor less than a machine, which no wise operator meddles with when it is working satisfactorily and delivering results.

"The employe in a factory or in any line becomes more valuable the longer he serves and keeps in good working condition, just the same as the machine runs more smoothly as the rough edges wear off its parts.

"The Detroit Insulated Wire Company finds the machine is running to its satisfaction; it has worn smooth through the continuous connection of its parts and it intends to keep those parts, represented by the individuals who produce for the company, in good working order.

"We approve, as all must approve whose sincere interest is for a contented Detroit, on its industrial side, of the kind of oil the company has decided to use.

"It certainly will not clog the machine.

"While the company says to the men, 'We give you this bonus so that you will not leave us and to insure ourselves against loss in the impairment of our organization and producing power,' and thereby admits that the Christmas present is not given without the hope of benefit in return, isn't this a better and a wiser plan than that of the employer who holds back the pay for the first week or two weeks in the hope of gaining the same ends?

"And while it tends to benefit the company, is not the employe benefited, especially the one of rolling stone tendencies, the profits from whose labor and energy are expended between rows with foremen?

"Appealing as it does to all branches and to all stations in the company's factory, the seasonable remembrance of these employes should result in a better understanding all around and in a cooperation that will prove helpful to both the recipient and the giver."

The Lighting Situation.

BY LOUIS BELL.

The past year has been one of interesting progress in minor lighting matters, but has been marked by no sensational developments whatever. The lighting business has, from the standpoint of the central station, been rather prosperous. There has been no ground lost and a good deal gained, so that altogether the outlook is a cheerful one. The material of the lighting art has undergone no considerable modifications. The advent of the so-called wire-drawn tungsten lamp is a matter of considerable technical interest, but it is somewhat early as yet to predict its effect as a whole. Tungsten is far from ductile at ordinary temperatures and the German experimenters found great difficulty in making tungsten wire that would retain its ductility after it had been in use in an incandescent bulb for a hundred or two hours. Just how far the American makers overcome this particular difficulty, how far in fact it is possible to overcome it, remains to be seen. It is not all improbable that some at least of the undesirable properties of both tungsten and tantalum wire may be avoided by better methods of purification. It is quite certain that tantalum wire suffers from impurities and it is more than likely, considering the enormous melting point of tungsten and the difficulty of refining it, that it also may be subject to similar faults. However this may be it is the pretty general experience of the usuers of tungsten lamps under whatever alias sold and by whatever process manufactured that the quality of the product has of late materially improved. In particular breakage in shipment has been greatly reduced and the percentage of early failures seems to be somewhat less than formerly.

It is worth noting that during the past year the tungsten lamps in smaller sizes, fifteen watts or thereabouts, have begun to appear in the trade and seem to be giving a fairly good account of themselves. The logical tendency is toward the use of these smaller units in many cases, the psychological tendency always works in the direction of higher rather than lower candlepowers, so that it is not by any means certain that these smaller lamps will come into considerable commercial use at present. At the other end of the scale the large tungsten units of 150, 250 and even 400 and 500 watts have begun to make a considerable showing, particularly in the two smaller sizes mentioned. The cost of the larger sizes is so great that early breakage is peculiarly discouraging and in the minds of many central station managers the life of the big incandescent units is not sufficiently well demonstrated as yet to justify their use on any considerable scale. Nevertheless, they are, like the smallest tungsten lamps, useful additions to the resources of the art. The largest sizes are readily applied to the replacement of the smaller ares where for one reason or another it may seem inadvisable to retain them.

Nothing much seems to have been heard of the helion lamp of late, rather to the regret of those engineers who were hoping for a high-efficiency filament of somewhat more rugged character than any at present available.

Incidentally it may be remarked that the tungsten lamps suffer from lack of intelligent standardization with respect to size and shape of bulb, and to fit them with proper shades is a task almost sufficient to drive the illuminating engineer to drink. The bulbs of any given capacity of tungsten lamp vary as between maker and maker and as compared with the sizes of carbon lamps just enough to make the shades which fit one nicely wrong when used with the other, a difficulty which is made all the more exasperating on account of the tendency toward making the three smallest sizes of tungsten lamps all with bulbs of the same size. For instance, a certain excellent and widely used type of glassware gives an admirable effect when used with one twenty-five-watt tungsten lamp, but inefficiently screens another type of which the shape of the bulb and the depth of the bowl frosting is slightly different. The thoughtless observer might fancy that he detected here a shrewd trade trick, but on the contrary the identity of the articles would, if mentioned, make it perfectly clear that the trouble was simply due to lack of foresight on the part of somebody. Incidentally it is quite impossible to fathom the reason for making the ordinary twenty-five-watt tungsten lamp just enough bigger than the old standard sixteen-candlepower lamp, so that the closed globes which fitted the latter will not fit the former. These are small matters, but they are as annoying as it would be to have three or four kinds of screw threads in commercial lamp sockets. Things of this sort will undoubtedly be remedied in a few years but with the long experience that has been had in the incandescent lamp industry already they should never have occured at all.

In arc lighting perhaps the chief advance has been in the rapidily increasing use of the intensified arc particularly for lighting in which exact color values have to be preserved. The intensified arc is easily the most convenient illuminant for such cases, but until within the past year it has been in this country rather in an experimental stage, although pretty thoroughly developed abroad. The coming year should see great increase in installations of these ares which are not only singularly well adapted to their use but considerable more efficient than their predecessors. It is interesting to remember that some of the earliest experiments in the intensified ares were tried in Chicago, although as a matter of fact most of the subsequent development has taken place on the continent, until recently.

Of flame ares a large number are now in service representing many makes, mostly foreign. There seems just now a tendency somewhat toward the use of the white flame carbons and the principal effort of the inventor is in the direction of longer life which has been conspicuously the weak point of these lamps in the past, and the outlook for longer life is now rather hopeful so that one may reasonably look forward to a decreased cost of carbons due both to improvement in life and to better facilities for manufacture in this country. It may be added that the white flame carbons referred to are considerably more effi-

cient than the earlier examples so that the difference between the yellow flame and the white flame in luminous output per watt has been considerably decreased.

Perhaps the greatest progress in ares has been in the production of better and more efficient luminous ares of the magnetite type. The old four-ampere magnetite arc is of course still in considerable use, but lamps burning at six or seven amperes and even at nine and ten amperes are doing admirably, and the former have been installed in a number of cities with most excellent results. The great desideratum at present is a good arc of the flaming or luminous sort adapted for use on alternating-current circuits.

The titanium lamp, of which considerable hopes have been entertained in the last two or three years, has rather fallen into disrepute and the tendency now is to use magnetite arcs with mercury rectifiers in its place. Without going far into the technical discussion of the difficulties with the titanium arc the substantial fact is that the best burning condition of the arc has up to the present been secured only with current too small to ensure suitable stability in operation. It is to be hoped that a type of arc so remarkable for its luminous efficiency will be pulled out of its present difficulties.

In street lighting it is pleasant to record a steady improvement toward better things. In a number of cities the activity of merchant's associations has been displayed in greatly improving the lighting of streets even where the city did not feel justified in increased expense, and the cities themselves are certainly moving in the direction of improvement. A good bit of somewhat flamboyant lighting by ares has been installed in which the illumination has been carried, chiefly by the use of double lamps, decidedly higher than even the severest requirements of first-class street lighting would suggest. It is certainly better to overdo street lighting than to underdo it, yet by the exercise of discretion it is certainly possible to distribute the light through the city more judiciously than has been the case in some recent instances.

The larger sizes of series tungsten lamps, say of 100 to 150 watts have demonstrated their usefulness in many instances and these lamps could replace with small added expense and with admirable results those smaller units which were designed chiefly to replace the old carbon street lamps.

The improvements in street lighting by gas will undoubtedly help on the cause of more liberal electric lighting. In fact one is almost tempted to intimate that the invention of greatest benefit to the electrical business since the incandescent lamp is the Welsbach. It was not loved at its first coming, but it is perfectly safe to say that without its competition central station lighting would today be on a smaller and less profitable scale than it is.

The line of improvement most needed in street lighting seems to the writer not a matter of material but of its application. A better recognition of the relative importance of streets from the standpoint of illumination is sadly needed. The popular tendency is generally toward an allowance of a certain sum per mile of street, which tendency always leads to mediocrity and results in important streets being too little lighted and unimportant ones altogether too much lighted. There is no more need for lighting all the streets of a city all alike than there is for paving them all alike and when this fact is recognized the secret of efficient and economical lighting reveals itself.

Incandescent Lamps in 1910.

BY CHARLES F. SCOTT.

The progress of the incandescent lamp in 1910 should be prefaced by a perspective glance at the history of this lamp.

The carbon incandescent lamp may be said to have been the basis of the electrical industry. Beginning some thirty years ago, the incandescent and the arc lamp were, for many years, practically the only consumers of commercial current. The carbon incandescent lamp is to-day used in larger numbers than any other electrical device; it is used by more people, and through it the public has had its most intimate and familiar acquaintance with the use of electricity. Furthermore, the carbon lamp through which electric power became commercial and which still holds important rank, has changed but little in all this period. Its form, size and appearance have not materially changed and the ordinary observer would note but few differences between the earliest lamps and those of to-day. Improvements have been made in methods of manufacture, resulting in more efficient and vastly cheaper product.

During the past few years, the tungsten-filament lamp has been introduced, and its use has been rapidly extending during the past year. Along with the new type of lamp has come a general impetus, not only to the manufacture of incandescent lamps, but to a study of the methods of using them. In connection with this general survey the following points are to be noted with regard to the recent advance in the manufacture and use of incandescent lamps:

1.—Rule-of-thumb methods are rapidly giving way to scientific methods. Incandescent lamp manufacturers are depending more upon the scientific expert than the individual experience of older foremen. Scientific research and development work are leading to modifications in old processes, and the establishing of new methods. They are finding a large use for scientifically trained young men, and on the other hand, college graduates are finding an enlarging field of possibility as scientific experts, as manufacturers, and as commercial illuminating engineers in connection with the incandescent lamp industry.

2.—The increasing excellence and the more intelligent application of the metal-filament lamp, particularly in sizes larger than the ordinary carbon lamp, is greatly extending the field and the usefulness of the incandescent lamp.

3.—The increased knowledge of the metal tungsten and the improved processes of manufacture are producing commercial lamps of greater uniformity, higher efficiency, and greater strength. The effort toward a practical single, continuous filament, instead of a number of hair-pin shaped loops,

has met with commercial success by one manufacturer, the Westinghouse Lamp Company, which has also devised a method of securing the two ends of the filament to the leading-in wires in such a way as to avoid rigid joints while securing ideal electrical contact. This type of construction insures a remarkable gain in the mechanical strength of the filament in the lamp.

4.—A great impetus has been given to the scientific study of illumination, particularly with reference to the effective distribution of light through the proper placing of lamps, and the use of efficient reflectors. This has been brought about largely through the use of tungsten-filament lamps of candlepowers intermediate between the carbon lamps and the arc lamps, which have afforded a means of economically replacing the arc lamp by several units of less intensity, thus securing superior illumination in large interiors.

5.—The active interest presumably inspired or largely promoted by the interest in metallic filament lamps, resulted in the phenomenal course on illumination held at the Johns Hopkins University with an attendance of over 200 for two weeks.

6.—The intelligent attitude of manufacturing companies, both of lamps and of reflectors and similar appliances toward the problems of illumination is resulting in a general campaign of education among the users of lamps. Central station managers, architects, and the general public are awakening to a realization of the new era which is opening in illumination. This has been accompanied by a noteworthy advance in the use of lamps in various industries in which the suitability of metal-filament lamps for general use is being demonstrated.

7.—There is an increasing use of incandescent lamps. A railroad company which is one of the largest users of incandescent lamps in the country, now consumes twice as many lamps as it did two years ago.

8.—The new relation between the power used and the light produced, which is brought about by the tungsten-filament lamp, is having an effect upon central station income which is awakening a new interest in the rate and method of charging for electric service. As the whole matter of some sort of charge for electric power, other than a uniform kilowatt-hour rate irrespective of the amount of power used or the time of its use, is of great importance in the extension of the use of electric power, it is fortunate that the tungsten lamp is forcing its consideration.

9.—The relation between good illumination and human efficiency is being recognized. Illumination is not merely a physical problem, it is also physiological and psychological. The good-cheer which bright surroundings brings, stimulates to activity in marked contrast to the depressing surroundings which poor light produces. This has a distinct commercial value in the office and the workshop. Men are able and willing to do more work and better work with good light—light good not merely in quantity, but in quality and in location and distribution. Only a few cents additional cost per day may change poor lighting to good lighting and increase greatly the output of high paid employees.

The advancing scientific study of illumination, the improved lamps and accessories which are becoming available with their enlarging field of efficient application and the growing appreciation of the social and economic value of good illumination, are factors by which the incandescent lamp has contributed in 1910 toward the new era in illumination.

Electric Furnaces.

BY CARL HERING.

Just as the dynamo, the arc lamp, the incandescent lamp, metal filaments, alternating-current transmission, wireless telegraphy, the storage battery, and other typical inventions, all passed through a short period in their history during which they developed rapidly from a well-known but undeveloped device to a very practical and highly-perfected commercial article, so it may be said that the electric furnace is at the present time going through a similar period of rapid rise in the history of its development. Like the others, before their period of rapid development, the electric furnace is not a new device; it has long been known in its crude form and, in fact, has been used commercially for many years in its simple forms; but it was only comparatively recently that the principles underlying the proper designing, proportioning, construction and operation began to be more clearly understood and are bringing it within the sphere of engineering.

Electric furnaces of the not very distant past may be likened to the dynamo of the late seventies and early eighties, when the only way to build a dynamo was to buy or borrow the best machines, test and measure them, make as good a guess as one could as to ways for overcoming their faults, suggest a few new theories and then end up by copying the older machines, making whatever improvements that cut-and-try methods showed were good, discarding those that were found to be bad. Such a thing as predetermining the proportions of a dynamo for a given duty on a rational basis, as could be done with a steam engine, for instance, was unknown; the best one could do was to determine by proportion what the dimensions of a larger machine would probably have to be, from those of a smaller one, or the reverse.

It was even thought, in its earlier history, that a dynamo should have an internal resistance equal to the external one, in order to give the greatest output, because this was the well known law concerning the use of the then best known generator, the chemical battery. Some designers of the "practical" kind, who have no use for so-called "theoretical" work, tried their best to eliminate the counter electromotive force of motors because they claimed it interfered too much with getting current through the motor. Many wasted their own efforts and other people's money in trying to make a theoretically impossible commutatorless direct-current machine, so as to overcome the then serious commutator difficulties.

Others thought the only salvation was in the unipolar machine, one inventor believing he had accomplished it by merely omitting (mechanically) one of the poles of a regular bipolar machine, which at least enabled him to call it a unipolar machine. The strife between the advocates of the ring and the drum armature was acute; the question of "dead wire" on the armature was hotly discussed; some omitted the core of the armature, and so on.

But the freak machines were soon eliminated by nature's effective method, death. Engineers and scientists took hold to find out the true underlying principles of the dynamo, especially as to commutator sparking, and to deduce or discover the true laws for proportioning them; science and engineering triumphed over the older slipshod and expensive cut-and-try methods, with the result that the present dynamos and motors are a monument to the skill of the educated engineer. There are probably no other transformers of one kind of energy into another which are as highly efficient as the dynamo and motor.

The history of electric furnaces bids fair to be a duplicate, at least to some extent, of this history of the dynamo. The early Siemens furnace, consisting of an arc in an open, uninsulated crucible, undoubtedly could melt iron; one of the electrodes was hollow so that it could be water-cooled to near the end to keep it from melting away. It was a furnace, but in name only, and although it was an interesting device, it could not be called an engineering structure.

The patent office is full of patents for electric furnaces of the freak type which had evidently never been tried, and many of which would probably generate cooler and less useful heat than if a bon-fire were made of the paper on which they were printed; and it will probably never be known how many other applications for patents did not survive the death blow of that rule which permits the patent office to require a working model.

The present era of the electric furnace seems to be that period at which rapid development is taking place. The field for them has suddenly opened wide; everybody has new ideas; whether they are wise or otherwise, the law of evolution concerning the survival of the fittest will decide for us.

The development is taking place in two distinctly different directions, that of the inventor, and that of the engineer or scientist. The inventor tries to devise new methods, devices or combinations stimulated by the idea of keeping others from using them by getting the seventeen-year government monopoly for them. The engineer and scientist, stimulated by the desire to help each other, work out the principles underlying the proper design, construction and operation, and freely contribute their results for the benefit of others. The work of both is important, and the most valuable results are generally obtained when both cooperate.

The inventor points out the possible combinations of elements; the engineer determines which of them are practicable. Ideas which during one period of development may be classed as freaks, may at another survive those which were at first thought to be more sound. The inclosed arc lamp is a good illustration. When shown at the Philadelphia exhibition in 1884 it was classed as a freak; now it is fast replacing its early competitor. The frail Welsbach mantle, wireless telegraphy and telephony are other illustrations. So-called freak ideas should therefore not be ignored on general principles; sometimes they are worthy of consideration.

Fortunately for the development of the electric furnace, there are no controlling basic patents; the field is wide open. Improvements in the form of inventions, as distinguished from designing and proportioning, are therefore to be looked for in details rather than in any radically new way of converting electric energy into heat other than by means of resistance, although other ways may be possible.

Aside from the furnace itself, there is of course a very wide field open to inventors in devising new thermochemical processes for treating materials with the aid of the electric furnace, and it is in this direction that valuable improvements may be looked for.

Considering now the second branch of the development, namely, that in which the engineer and scientist are concerned, as distinguished from the inventor, it is probable that it is in this branch that the most important progress will be made in the immediate future. It is a simple matter to produce an arc between two carbons, thereby getting instantaneously probably the highest temperature which can be produced artificially on a commercial scale today, but such a device cannot or should not be dignified with the name furnace. Nor should it be called so when the arc is simply enlarged in scale. The same is true of a wire carrying a current by means of which the volatilization temperature of the conductor can be produced in a very short time. To be a commercial furnace it is necessary that it operate continuously, with reasonable certainty and with as few stoppages as possible; also with the least possible losses, and with as little expert attendance as possible. It is here that the work of the engineer becomes important; it is for him to determine how to design, proportion and construct a furnace so that it may deserve to be classed among engineering structures.

It is therefore in the careful study of the proper designing and proportioning and operation of furnaces that the greatest and most important progress is to be looked for today. And it may be said that development in these directions has only just begun.

To calculate proportions requires a knowledge of the physical constants of materials, such as their thermal and often also their electrical conductivities, more particularly at high temperatures; also their specific heats, the melting and often also the volatilization points; the combination energy when compounds are formed or decomposed; the laws governing the various thermal phenomena, including the flow, convection and radiation of heat. Much, if not most, of this fundamental knowledge does not yet exist or is only crudely known, or perhaps even worse, as it has already been found in some cases that what we thought was known was actually wrong and had been misleading us.

We must therefore not only learn new things, but even unlearn some of the things we had learned. It was, for instance, commonly thought only a short time ago, that if the electrodes were good heat conductors they would necessarily chill the furnace product, and would therefore be wasteful and objectionable; this has since been shown to be entirely fallacious, as copper, for instance, which is one of the best thermal conductors, is far less

wasteful of heat when used as an electrode material than the much poorer heat conductor, carbon. Carbon, which is perhaps the most commonly used electrode material, is now known to be one of the least economical as far as heat efficiency is concerned.

Graphite was, on account of its better thermal conductivity, long considered to be more wasteful in heat loss than carbon, when as a fact we now know that it is just the reverse.

It was commonly thought but a short time ago that by simply increasing the number of watts per cubic inch set free in the material it could be melted or even volatilized, no matter how infusible it was, and that there was nothing impossible about so increasing the watts. But we have since learned that this too is wrong, as it is a physical impossibility to increase the number of watts set free in a channel of a liquid conductor beyond a certain limit, on account of the so-called "pinch" phenomenon; and this limit is a very positive one, and is sometimes reached even at very low temperatures, so low in fact that in some cases even simple fusion cannot be undertaken commercially.

It was long thought best to cool the outer ends of the electrodes, but it is now known that it would be economy of energy to heat them with a blast lamp as hot as other conditions permit. The size of furnace electrodes was formerly based on current densities, while now it is known that this was a mistake, and that current densities are no more a determining factor in calculating electrodes than they are in calculating transmission lines.

These few illustrations show that there is still much to learn and some things to unlearn before furnaces can be designed and proportioned correctly.

Moreover the electrical conditions under which large furnaces operate are in some respects so different from those encountered in the more usual applications of electricity that new phenomena, not noticed before, may be expected, and they may seriously interfere with the proper operation. As an illustration, the radial pressure toward the center, which we now know exists in all current carrying conductors, was not noticed until very large currents were passed through a relatively small liquid conductor in a furnace, and under those conditions this heretofore unknown force became very powerful, enough so to actually part the metal, as though it were being pinched off, hence its name, "pinch" phenomenon.

The passage of such large currents through mobile liquids which can readily yield to forces, may produce still other phenomena than the one just mentioned. The mutual repulsion of two arcs in series with each other, or their attraction when in parallel, both arcs playing on the surface of the molten material, may become serious in large furnaces.

The passage of a large current through a liquid conductor in a magnetic field is now known to make it act as though it had changed its specific gravity, whereby, for instance, rock, aluminum and other light materials may be caused to float on water, or wood be caused to sink in mercury. Hence segregation favorable or unfavorable, may perhaps be produced in heterogeneous materials in a furnace, by the passage of a large current through it. The magnetic field of the current itself may become quite formidable when the currents are so large.

Such unexpected, though easily explained phenomena, show that there are probably other things to be learned under these quantitatively new conditions, and that it may not be safe to base predictions on our knowledge and experience with currents under ordinary conditions.

To design and proportion an electric furnace with the idea that it is a mere heater would in not a few cases lead to absolute failure. It is necessary to take into account whether the chemical reactions produced are exothermic or endothermic, that is, whether energy is set free or consumed by the chemical reactions. The latter is perhaps more frequently the case, as in the reduction of aluminum, iron, zinc, etc., and presumably in the production of calcium carbide; hence, if no allowances are made for it in the calculations, the furnace cannot possibly turn out the expected product. Here again the furnace engineer finds that there is a serious lack of knowledge as to this so-called heat of combination, without which he cannot predetermine the results.

In the high temperature of the carbon arc, compounds may dissociate, hence on cooling they may recombine in a different way, forming undesirable products. The usually inoffensive nitrogen may even become chemically active at such temperatures. Here again there is a lack of knowledge of the dissociation temperature, the temperature of arcs between other materials than carbon, the relative chemical affinities at such temperature, etc.

These few illustrations, and many more could be cited, show that what might be termed our knowledge of the science of electric furnaces is still in a somewhat crude and undeveloped state. Heat is a low form of energy to which all other forms tend naturally to degenerate; hence to simply produce heat from energy of the very high state of availability of electric energy is no difficult task, as nature tends to do it for us. But to do it commercially, without undue waste, and so that it will produce the desired product, involves no small amount of knowledge and skill on the part of the engineer, and it is in the acquiring of this knowledge that the development in electric furnaces is to be looked for at the present time.

It is when the engineer can predetermine whether a desired furnace operation is possible or not, and if so, whether it is commercial, that much progress and less failures by the cut-and-try method are to be expected. Calculations, when it is possible to make them with reasonable certainty, are generally far cheaper than blind cut-and-try methods.

The cost of heat by fuel, per degree of temperature, increases as the temperature rises; in fact a temperature is reached where the efficiency is zero; that is, where the material no longer gets hotter, the gases (including the very large amount of the useless nitrogen) carrying away all the heat generated. With electricity generated heat, however, it costs no more to produce a high-temperature calorie than one at a low temperature. Hence a point must necessarily be reached up to which it would pay best to heat with fuel and beyond which it would be cheapest to use electric heat, even though generated by coal, not to mention the sometimes very valuable advantage of the possibility of a neutral atmosphere in the electric furnace.

Electric furnaces are at present, and have been, in very successful commer-

cial use to produce probably thousands of tons of materials per day; hence, if they have been so successful in the present early state of their development, when our knowledge of their proper design, proportion and operation is still in a rather crude state, the prospects, when the engineer has developed them to the extent of perfection to which he has developed the dynamo, or even only approximating it, are very bright and encouraging. Already a number of new and very valuable products have been produced in the electric furnace which could not have been produced otherwise; the probabilities that their number will increase are therefore very great, especially when the furnaces can be designed to be less wasteful and more reliable. As the greater cost of the heat is often the deciding factor, the importance of heat economy, hence good design, becomes very great.

The great commercial importance of the electric furnace need hardly be emphasized here, but as an illustration its effects on the wealth of nations like Norway and Sweden are good examples. The barren and unproductive but readily accessible coast of the former will at no distant date develop important industries and bring great wealth to that country by the introduction of electric furnaces, the currents for which can be so cheaply obtained from the innumerable waterfalls. As for Sweden, with its great water power, the electric furnace bids fair to bring back its iron industry which it was in danger of losing due to the increased cost of charcoal.

Trend of Electric Power Application in the Iron and Steel Industry.

BY R. TSCHENTSCHER.

It is probable that the generated kilowatt "census" of January 1, 1911, and the installed motor-horsepower "census" of the same date, for the iron and steel industry, will show as large a percentage increase over that of January 1, 1905, as that of similar statistics in any other industry. The curve of generated kilowatts for the six years preceding January 1, 1905, displays a lack of activity in electrical development in this industry. At approximately this time, however, the curve departed abruptly from its previous course. The percentage increase of generated kilowatts at the beginning of 1911 when referred to that of 1905 is between 1,000 and 1,500 per cent. To assign the true cause for this condition would be quite difficult. Motors were used many years ago to drive mill tables and for miscellaneous purposes. It cannot be said, however, that these motors together with their controlling equipment when placed in the hands of the average steel mill operative of that time, constituted a very reliable operating mechanism. "Delays"—the bugaboo of the steel mill superintendent—were perhaps more aggravating than was the case with the more wasteful steam-engine drive which was replaced. Then too, time was necessary to overcome the usual prejudice towards a new form of power. Manufacturers of electrical equipment arose to the realization of the great possibilities for electrical power application in the steel industry. The standard railway equipment, which was perhaps the best to be offered at that time, did not possess the necessary ruggedness required for steel-mill service. A strictly steel-mill design was perfected and steel-mill engineers and managers were not slow in realizing the advantages of electric power application with the new equipment.

The gradual replacement of miscellaneous steam and hydraulic power was not difficult. The aggregate of this caused a material increase in the generating power station demand. The problem of operating the main rolls by motor drive was then attacked. The solution of the first few such problems resulted in installations so commercially desirable that in practically all future new mills motor drive exclusively was and is specified. Where but a few years ago mills abounded in leaking and rattling small steam-engine and hydraulic drives, now but comparatively few remain. Their high maintenance and operating cost compelled their displacement as soon as a suitable electric drive was available. In laying out new mills, ore docks, furnaces, or other department of the iron and steel industry an argument as to the kind of power drive seldom arises. The best possible method of electric power application only is sought. Steam or hydraulic power drives may safely be considered a thing of the past in the iron and steel industry.

Now, what may be considered as the trend of future development in electric power application? The continuation of the course of procedure outlined in the foregoing will continue. No hesitancy will be felt in the replacement of existing wasteful steam drives for the main rolls and the use of electric drive exclusively for all new mills. Ore-handling equipment at present operated by steam power will be remodeled and electric power substituted. The same applies to the handling of all other forms of raw material —coal, coke, limestone, etc. In order to keep pace with economies in other industries, the larger amount of hand labor which formerly existed in the steel industry and which exists to a considerable extent at present, must be replaced by efficient labor-saving devices, electrically operated. The blast furnace refuse—slag—is now used to a limited extent in the manufacture of high-grade Portland cement. A valuable adjunct to the iron-making industry has therefore been established and its expansion with considerable rapidity is assured. All modern cement-mill equipment is electrically driven. As this has proven so uniformly reliable and economical no alteration need be anticipated and a large generator and motor increase is assured. A more consistent and increasing use of electromagnets for handling pig iron, scrap, and finished material will be witnessed. The existing commercial electromagnet is a most versatile tool in the hands of the steel man. The numerous difficulties encountered in the daily operation of such magnets have been overcome and a reliable affair produced. Steam locomotives must also in time give way to those electrically operated.

The power demand for the foregoing will continue to be on an increasing

scale. It therefore becomes a vital problem to obtain cheap reliable generated power. The first requisite of this is of course, cheap B. T. U. The average steel plant and particularly the combination iron and steel plant has a number of sources of such cheap B. T. U. A plant into which comes as raw material, ore, limestone, coke, and out of which passes finished steel product suitable for the contractor or other user, abounds in what until but a few years ago were considered as "waste gases." The blast furnace has its quota of waste gases with a heat value of 100 B. T. U. per cubic foot, created in the process of making pig iron. Sufficient surplus heat energy exists over local requirements, to permit the generation of over 150 kilowatt-hours per ton of iron. The open hearth furnace has its waste gases available at approximately 1,200 degrees Fahrenheit. Sufficient surplus heat energy exists over local requirements, to permit the generation of more than fifty-kilowatt-hours per ton of steel. The various mill reheating furnaces have waste gases of considerable volume. The surplus available for electric power generation depends locally on the kind of finished product of the particular mill. The temperature of these waste gases is usually high, averaging well up to 1,000 degrees Fahrenheit.

A further source of waste heat is obtained from existing steam engine exhaust, either that discharging into the atmosphere or into a condenser. The low or mixed-pressure turbine, with or without regenerator, depending on the local condition, readily utilizes the energy which the reciprocating steam engine cannot as economically digest. The energy from existing pumping plant exhaust may also be taken care of in this manner. A plant which the writer has in mind, in which all of the sources above enumerated are available, may be arranged to produce more than 75,000 kilowatts without requiring any coal for steam generating purposes.

The operation of coke ovens supplies a vast amount of waste heat which may be utilized for electric power generation. The available power from this source may be considered approximately 150 kilowatt-hours per ton of coke produced. This will of course vary with the type of oven, kind of coal, coking time, etc. A 300-oven plant producing 100,000 tons per month would supply sufficient energy for generating approximately 25,000 kilowatts of electric power.

The iron and steel industry under existing conditions of operation, thus has the means of obtaining a large amount of comparatively cheap power.

A source of considerable electric power demand will be occasioned by the installation of electric refining furnace plants. This type of furnace has been in commercial operation for some time and may be considered as no longer in the experimental stage. When one realizes that a 60,000-ton per month electric furnace plant will require roughly 15,000 to 30,000 kilowatts, depending on the character of the work performed, an idea is obtained concerning what the future has in store in electric power application in the iron and steel industry. A still further view into the future brings up the problem of the electric reduction of iron from the ore. This step may be conceived to be followed by a single-process method of electrical reduction of steel direct from the ore. The power requirements for the realization of either or both of these problems would comprehend power-generating capacity compared to which present conditions are insignificant.

Electrical Progress in Great Britain During 1910.

BY ALBERT H. BRIDGE.

The year 1910 has been one of victory for all classes of electrical illumination. Everywhere the metallic-filament lamp has been carrying everything before it, but the period of its temporary adverse effect upon the lighting load of electric supply stations is not yet ended. The changing situation has, in most places, been met with determination and with confidence in the future; by employing measures of continuous aggressive commercial development, opening public showrooms, using enlightened and adapted co-operative publicity methods, altering charges so as to give an impetus to heating and cooking business, the anticipated increase in consumers has been secured.

We have added new factories for making metallic-filament lamps in England, but how far we are equal to the abnormal demand while the change is proceeding may, to some extent, be gathered from the fact that we are importing every month from Continental countries electric lamps to the value of $300,000.

Opinions vary as to the exact point that we have reached on the change-over journey, but I may quote the view of an authority controlling many installations of different sizes and classes in different parts of the kingdom, which is that the full effect of the adverse influence has been felt so far as shops and business premises are concerned, while in private houses there still remains a wide field for superseding the carbon-filament lamp.

Alterations of many kinds have been taking place in systems of charging here in the hope of securing small lighting or heating consumers, with the desire to make the consumer pay more per unit so as to prevent too heavy a revenue drop; speaking generally, where higher rates have been introduced the wisdom of such a policy has been questioned. Municipal authorities have shown a great desire to supply house installations and wiring, and this has put a flea in the ear of the electrical contractors, who have been waging war against rate-aided competition, though a dose of "unofficial conference" chloroform has silenced the offending insect while efforts at compromise proceed. The subject has to be mentioned here, as it has been one of the outstanding controversies of the year. Very successful results have attended special efforts made at Liverpool, Eccles, Poplar and other places, to win the cottage and low-rental resident over to electricity as "the poor man's light," and at Aberdeen even the smallest cottages are now wired and fitted with metal-filament lamps. Similar progress is being made

by the "Fixed Price Light" arrangement that was announced early in the year. Marylebone has thrown out its line to catch additional load at desirable hours by offering a special rate for electric-vehicle battery charging (one cent per unit for a minimum annual consumption of 100,000 units), but this is a branch of electrical work in which England is lamentably behind.

In electric lighting for streets and open spaces the progress of 1910 has been greater than in perhaps any preceding year. The flame lamp and the high-candlepower metal-filament lamp have superseded gas lighting in many places.

Remarkable results have been attending the scrapping or overhauling of old plants in search of the more economical production of energy which the altered lighting situation has rendered imperative. The Grove Road Station (London), after its partial conversion to turbine working, reduced its total costs per unit from 0.97 pence to 0.44 pence (forty-four per cent saving). Southwark has found that by spending $35,000 on turbine and condensing plant it can save twenty-five per cent in fuel charges. Hampstead, by spending only $90,000 capital, can effect an annual saving of $20,000. Edinburgh by erecting cooling towers is to save $17,500, or thirty-five per cent of its coal bill annually. St. Pancras, by pulling down old and extravagant boiler plant, and reorganizing its various works, finds that it can reduce its costs from 1.02 pence to 0.69 pence per unit. Lancashire Electric Power Company, by spending $15,000 upon its power station, so increased its efficiency as to reduce coal consumption by twenty per cent. Saltburn Electricity Works, which started with gas-engine equipment, and replaced that by a steam plant, has superseded the latter by a Diesel oil plant, and its fuel costs, which, for gas, were never below 0.5 pence, or for steam never below 0.6 pence, have been only 0.172 pence per unit with an oil plant. At Rhyll a Diesel plant in supersession of early steam plant has reduced fuel costs from 0.9 pence to 0.2 pence per unit. These are samples of the kind of engineering reorganization that has either been carried into effect during the year, or is now in contemplation.

New power stations installed during the year have included that of the Westminster Electric Supply Corporation at Horseferry Road, superseding the old Millbank works. A number of 1,000-kilowatt turbines each drive two 500-kilowatt generators in tandem, and the station is intended to contain 14,000-kilowatt motor-generating plant, the motors working with three-phase, 6,600-volt current supplied from a "joint" station, transforming it to 440 volts. Dundee Corporation has opened its new power station at Carolina Port, of which a full description appeared in this journal. Here an extra-high-tension, alternating-current, three-phase plant supplies current at 6,600 volts, fifty cycles, to three substations for feeding the three-wire direct-current network at 400 volts for lighting, power and traction. Good progress is being made with the large power station of the Newcastle Electric Supply Company, which will ultimately be larger than that at Carville. The Company has been adding new substations in a number of outside districts in its area not previously served, and at Carville it has added a transforming plant (four 4,000-horsepower) for meeting the increased demands of collieries. The South Metropolitan Electric Light & Power Company has installed a new extra-high-pressure transmission installation at Catford, marking the adoption for the first time in England of the Scott system of transformation from two to three phase and vice versa. The Clyde Valley Power Company has added a further 5,000-kilowatt turbo-generator, bringing the total generating capacity of its two stations to 18,000 kilowatts. This company has twenty collieries and a number of iron and steel and engineering works on its mains, while it also gives bulk supply to three towns. The General Post Office has opened its power station and substations for the electrical service of its new King Edward Buildings in London. Bernard Samuelson's Iron Works at Middlesbro, the plant which utilizes the exhaust steam from blast-furnace blowing engines, has been extended, including two 1,250-kilowatt three-phase, double-flow, reaction-type turbo-generators. Here the waste-heat owners and the electric supply companies are acting in co-operation. Bradford Corporation has added two 5,000-kilowatt vertical Curtis turbine sets to give three-phase 6,600-volt current. Wednesbury Corporation has added a gas-driven plant (fed with Mond gas) to its steam-driven sets. Diesel and suction plants are increasing in favor for small localities. Yorkshire Electric Power Company has added a fourth turbo-generator. It is now carrying its overhead line westward to serve a large cotton mill, collieries, etc., and eastward at Castleford to supply a large colliery. Like most other power companies it has improved its position admirably during the last year or two. At the Coltness Iron Company's works at Newmains, a plant has been installed for utilizing the slag from the blast furnaces for cement making. Three gas engines (Cockerill-Westgarth) have been installed—two for blowing purposes and one for coupling to a 1,000-kilovolt-ampere three-phase slow-speed, revolving-field alternator, the energy being used to drive the tube mills and conveyors, also the cement mill, which has a normal output of 1,000 tons of cement per week. The West Hartlepool Corporation is about to erect a second plant costing $85,000, near to the iron works of the Seaton Carew Iron Company, under special agreement for the use of waste heat from the blast furnaces, for generating purposes. The Fife Coal Company has been installing an extensive electrical power system at its Leven Pit. The Rosyth Naval Base station is using 30,000 units per week for various purposes in connection with the large operations that are proceeding there by Government contractors. There are nearly two-score traveling cranes, also concrete mixers, boring and pumping machines, and arc and incandescent lighting, as well as a stone quarry a mile away consuming 300 kilowatts in stone-crushing operations; this installation comprises altogether eighty motors of three to eighty brake-horsepower, eighty arc lamps, and 2,000 incandescents. The plant is running night and day. The Cornish Electric Power Company, which has had to sleep for so long, is arousing, for the tin and other mines and works are now more promising as electrical users than at any previous stage of their history. The North Metropolitan Electric Power Company is "striking oil," for it reports an increase of 16.5 per cent in its business. Glasgow Corporation, being obliged to erect an additional power station in order to prepare for the future, has secured land on which to build shortly.

At Harrison Ainslie's collieries, where unforeseen difficulties arose with the original electric pumping installation,

torily that ten new electric pumps were ordered, making the plant the largest of its kind in the United Kingdom. The Manchester Corporation found a useful large consumer in the Brunswick spinning mill (the writer described the installation in these pages at the time), which is one of the largest single-mill equipments in the country. The corporation supplies a 6,500-volt current for transformation to 400 volts, and there are thirty-seven three-phase induction motors (1,640 brake-horsepower aggregate). The management states that the more regular turning gives an improved quality of yarn, and a larger production from the same machinery. A breakdown of an old main driving engine at Ravensthorpe Mills advertised the electric drive very effectively, for by taking only ten days to restart the entire works electrically, a five or six months' wait, which would have been necessary for the repair of the old engine, was avoided. The year has witnessed better headway in the electric equipment of works generally, including textile factories, flour and paper mills, dockyards, printing works, irons and steel works, etc. The iron and steel manufacturers have been somewhat aroused from their lethargy, especially at Sheffield, where a number of furnaces are now on the public mains. For an English mill a large rolling-mill motor of 10,000 horsepower has been made for direct coupling to a thirty-six-inch cogging mill and finishing mill for rolling two and one-half ton steel ingots down to rails in one operation without heating the billet. A 1,000-horse-power Ilgner motor-generator set with sixty-ton flywheel supplies energy to the mill motor which will reverse at the rate of thirty times per minute.

In the tramway field there is little progress to mention. The Bournemouth Corporation is replacing its conduit tramway by trolley, making its system uniform and far more economical and convenient to operate. Torquay surface-contact lines failed to secure a renewal of their Board of Trade license owing to unsatisfactory working, and, as a result of arbitration, the trolley will come there directly, though temporarily, the stud-contact cars are being allowed to run. The last piece of cable tramway has now disappeared from London, Highgate Hill having been electrified this year. On the Woolwich-Eltham tramways (London), owing to the objection of the Board of Trade and the Admiralty to the use of overhead trolley with a single insulated overhead conductor and return through the rails, two overhead wires have been placed to each track instead of one. Two towns are engaged in putting up overhead work for a trackless-trolley service; they are the first practical examples in the United Kingdom and will be watched with great interest. There have been filed for Parliament to consider directly, more than a dozen schemes for running such cars in districts not now served with tramways.

In electric railway traction important events have been few. Beyond recording the decision of the London, Brighton & South Coast Company to extend its single-phase line, and the experimental running, which is still in progress in Scotland, of the Reid-Ramsey turbo-electric locomotive, there is little to say beyond a hope that the joint meeting of American and English mechanical engineers in London in June will not be long in producing railway work for electrical manufacturers and contractors.

Turning now to the industrial and manufacturing sides of the subject, there has undoubtedly been more business done than in several preceding years, but prices, especially of larger lines of product, have not improved. Notwithstanding the larger volume, there is still insufficient to occupy the works to their full capacity, hence competition continues along its severe way. Manufacturers have been endeavoring to counteract the effect of reduced gross profit by increased economies and by greater manufacturing efficiency, but these ends are gained easier when a works is fully occupied. One large manufacturer admitted, at his annual meeting, that his works had had to take a considerable amount of business at works cost in order to keep things going. One gas-engine manufacturer has erected works specially for making large gas engines up to 3,000 horsepower in view of the big prospective development in that class. A well-known electrical works has begun to make Bergmann turbines of the impulse type in England by arrangement with a German company. Rolling stock makers continue to experience lack of orders for electric cars owing to the smallness of the new tramway operations, but they are looking for better things now that large numbers of cars should require renewal.

The controversy of tariff reform and its probable effects on the electrical industry, has been in full swing through most of the year, but none looks upon it as "a panacea for all the evils of cut-throat competition, insensate jealousy and excess of productive capacity from which electrical engineering works are at present suffering," to use the words of one authority. The National Electrical Manufacturers' Association has been reorganized. New life has also been imparted to the Electrical Contractors' Association. The committee for the Protection of Electrical Interests has set itself up and is getting to work. The joint publicity committee of the various metropolitan electric supply undertakers is hard at work driving into the head of the public by means of literature, advertising, and so forth, the advantages of electricity for everything. The export electrical trade during the year has been growing, the increase in value being somewhere in the neighborhood of ten million dollars, as the result of greater activity by manufacturers and agents all over.

The Institution of Electrical Engineers has increased its membership to 6,222, and during the year it has had the long-desired satisfaction of completing its own home on the Victoria Embankment after long years of hospitality under the roof of the Civils. The Institution has been criticised for taking too little interest in purely commercial and industrial electrical affairs, but, failing to obtain any alteration of policy from the council, the parties concerned have set up an outside and separate committee or association to overwatch industrial electrical affairs.

The law courts have been busier than usual during 1910 with electrical litigation. Metallic-filament lamp patents, the Ilgner patent, the G. B. surface-contact system, electric printing apparatus patents, train lighting matters, and now last of all radio-telegraph patents, have all added to the occupation of lawyers, and in some cases the results have been of considerable importance, especially the declaration of the courts that the Ilgner patent for control of electrically driven reversible rolling mills is invalid for want of subject matter.

Throughout the year a controversy has been proceeding concerning what is an equitable charge for an electricity department to make to tramway department for electricity for tramway

purposes. The Municipal Tramways Association and the Municipal Electrical Association, as representing the respective departments, have been sitting as a joint committee considering the standardization of a method of charging for such cases.

The new Society of Mining Electrical Engineers which has as yet a membership of 700 out of a possible 6,000 in the 4,000 collieries of the Kingdom, is trying to settle down to work to improve the status of colliery electricians and the safety of installations.

Ten million dollars have been spent upon the extension of the underground telegraph cable system, and 123 new Post-Office telephone exchanges have been opened. The post office and the National Company are busily engaged preparing an inventory and valuation of the plant, etc., of the company preparatory to the State assuming control at the end of 1911. The National Company has 18,000 employees, 516,888 stations, 1,569 exchanges; it is, therefore, not surprising that a staff of 300 is occupied and will be for the greater part of this year (1911), on the valuation, etc. In its last complete year the National Company transmitted 1,362,000,000 messages, an increase of thirty-nine millions, at a cost of 0.51 pence per message. The new Anglo-French cable with Pupin coils, four coils forming two telephone circuits, has been brought into service, and it is stated that the speaking value is improved by 300 per cent. This event is regarded as marking a new epoch in submarine telephony. The Post-Office has opened a large new telephone exchange at Glasgow to fit in with its future telephone development schemes. The War Office purchased 300 sets of wireless telegraph apparatus for army use.

The efforts of pioneers in the use of electrolytic hypochlorite for sanitary purposes have been continued with success, and a wider application of the idea to the purification of swimming bath water and the sanitation of schools is in sight. In that much neglected field—electricity in agriculture—there have been interesting experiments conducted at several places, with remarkable results. At Evesham, experiments in the electrification of crops by running wires discharging electricity over fields and through glass-houses, have shown that the electrified marigold gave eighteen per cent, strawberries twenty-five per cent, and wheat twenty-nine per cent greater yield than non-electrified crops. On the growth of cucumbers in glass-houses the results were greatly in favor of electrical treatment. Experiments have been proceeding along the same lines at Bristol and in Scotland.

The Year's Electrical Developments in Continental Europe.

BY C. L. DURAND.

In the present review of the progress which has been made in the various countries of the continent of Europe during the past year a number of enterprises in the different fields of electrical industry which are the most important in their scope have been selected and these will serve to show the general direction of affairs, although there are many others which we are obliged to omit. On the continent the most striking progress appears in the erection of hydroelectric stations and power lines, in electric traction, and electro-metallurgy. A satisfactory advance is also noted in wireless telegraphy, telegraph and telephone work and steam turbine plants.

As regards hydroelectric plants, we note some of the recent enterprises. In France, the Energie Electrique Company, which operates a large network in the Mediterranean region, has completed the new Ventavon hydroelectric plant on the Durance River. At present it is operating four turbine groups using Thomson-Houston three-phase alternators, with a total of 24,000 horsepower. The power line delivers current at 60,000 volts in the Marseilles district. There is some likelihood that the Rhone-Paris-power-line project will be carried out at no very distant date. A plant located on the Rhone near the Swiss frontier would afford 120,000 horsepower, and this would be brought to Paris over a 250-mile 120,000-volt power line on the three-phase system. Extensive work is to be carried out in Germany on the Aar stream and several lakes, and there will be five separate turbine plants erected, giving a total of 140,000 horsepower. Another large plant in Germany will use the water of the Walchen Lake and when completed it will furnish 40,000 horsepower. The great Rjukan hydroelectric plant in Norway is nearly finished at present, at least as regards the first station. The total fall of 560 meters is divided between two separate plants, and the first is to contain ten turbines of 14,000 horsepower each. Taking both stations, about 250,000 horsepower will be delivered. Naples is to secure a large amount of power from two plants on the Volturno stream, fifty-five miles distant. The second plant is added so as to bring the output up to 20,000 horsepower. A 45,000-volt power line will work in connection with the new city steam plant of 6,000 horsepower. On the Cismone River in Northern Italy is being erected a station which will be one of the largest in the country, giving 20,000 horsepower. At present there are erected three groups of 4,000 horsepower. Venice, Padua and other cities will receive current from this station. It is to be observed that long-distance power lines for large cities are on the increase on the Continent. Thus for Madrid there will be run a 50,000-volt three-phase power line from a new plant on the Tagus, using four turbine groups of 4,000 horsepower. The distance is about forty-five miles. Budapest is to take a supply from an affluent of the Danube. It is located at Soroksar and will give about 20,000 horsepower.

Extensive hydroelectric plants are being erected in nearly all the leading countries for operating power networks or for electric railroads. For instance, there will be several stations built in the Pyrenees region of France for electric railroads. One of these is located at Eget and a 25,000-horsepower plant is to be erected at Soulon in the same district. The industrial region of St. Etienne now has a large power network. In addition to the St. Victor steam plant there are two turbine stations lying at Olle and Riozonne. Another power network lies near the Swiss frontier and it is to receive current from power plants at Cize and other places. In Germany three different streams, the Nagold, Ems and Würm, are to supply 60,000 horsepower for traction and lighting purposes in the Baden region. In Austria a 20,000-horsepower station supplies the re-

gion of Innsbrück, and part of the current is used for electric traction.

Regarding steam plants, the St. Denis station near Paris is now running the Brown-Boveri steam turbines of the 10,000-horsepower size and has recently added a larger one of 15,000 horsepower. These machines are built at Paris by the Electro-Mecanique firm. The Lille tramway plant is using a 6,000 horsepower group. In Germany the Essen station now has five groups of 7,500 horsepower and two of 10,000 horsepower. Among others is the Rotterdam tramway plant is using a 6,000-horsepower. Many others might be mentioned.

Affairs are active in electric traction in all the leading countries. The state railroad department is engaged upon plans for running electric trains on the whole of the western suburban system which centers at Paris at the St. Lazare depot. An expenditure of $15,000,000 will be needed. The suburban lines carry a traffic of 50,000,000 passengers per year. For the inner zone a three-minute service will no doubt be used. The recent opening of the North-South subway line at Paris gives a much-needed transit across town and connects two of the principal railroad depots by a direct route. It runs in a double-track tunnel except where it crosses the Seine, and here two separate tube tunnels are used. The new line adds to the already extensive subway network, for which other new sections are being completed at present, one of these starting from the Place de l'Opera. Paris now has two principal suburban electric railroads, one of these being the part of the Orleans railroad, which uses electric trains as far as Bretigny. The second is a specially built electric line running from the city to Versailles.

The Paris-Lyons-Mediterranean railroad company is interested in a project for a railroad section between Gap and Barcelonette, in the south, and it will be the first step in the international railroad which is planned between Marseilles and Turin. One of the largest in France will be the sixty-five-mile section of the South railroads between Pau and Montrejeau in the Pyrenees region. It is intended later on to equip the entire 200 miles between Toulouse and Bayonne. Motor cars of 500 horsepower on the single-phase 300-volt system are now ordered from the French Westinghouse firm. In Germany, electric traction will be applied on the Freilassing-Berchtesgaden section of the Baden state railroads. Power is secured from a turbine plant on the Saalach stream. The Prussian state railroad is equipping the Dessau-Bitterfeld section and has already ordered 900-horsepower electric locomotives on the single-phase system. The Bavarian government is to equip several lines, among others the Salzburg and the Garnisch-Griesen sections. About $2,000,000 will be applied to this work. A new subway line is to be built at Berlin and it will run across from north to south, costing about $12,000,000. Matters are also active in Austria, and the railroad department has a special commission looking into the question in order to secure the required data. Hydroelectric power, which is plentiful in some regions, will be largely made use of. A suburban line is now running from Vienna to Baden. Single-phase current on the Siemens-Schuckert system is employed, using trains made up of motor cars. In the Tyrol, the new Trent-Male electric road has fifty miles length and is run by the Trent hydroelectric plant.

The Swiss federal railroad administration is taking measures to build the second single-track tunnel for the Simplon alongside the first one, according to the original plans. About $5,000,000 will be needed to carry this out. In the same region lies the new Bernese Alps railroad, which connects with the Simplon line, using the double-track Loetschberg tunnel to cross the mountains. The tunnel will likely be finished next year, as seven miles out of eight and one-half total length are now finished. Electric locomotives have been ordered from the Oerlikon and the Allgemeine firms, and they will be tested on the Spiez-Frutigen section, which is being equipped for the purpose, in order to obtain running data. Among others we note the lines belonging to the Rhätische railroad, which are to use electric trains. The Bevers-Schuls section is in construction, and also two other lines. Current is obtained from the Brusio hydraulic plant. A line is running from Martigny on the federal railroad and in the Rhone valley, to Orsieres. It follows in part along the St. Bernard route. Along Lake Thun is to be run an electric line connecting Thun with Interlaken.

An extensive railroad line in Sweden to be operated by hydroelectric power lies between the Kiruna region and the Norwegian frontier. As much as 80,000 horsepower for this and other purposes can be obtained from two hydroelectric plants. The line handles a considerable amount of ore from the Swedish mines.

In Italy 2,000-horsepower locomotives will be used on the section of the Mont Cenis railroad near Modane. They are of the Brown-Boveri three-phase type, operated at 7,000 volts. A new railroad is running between Brescia and Salo with ten trains per day, using an electric plant in Brescia. An eighty-five-mile railroad will run between Rome and Frosinone, with a branch to Frascati. We also note that electric trains will be used on the existing railroad between Pisa and Marina. Sig. Alessi has presented a project to the government for a tunnel through the Alps in order to connect Italy with South Germany by an electric road which will rival the St. Gothard line. The distance from Milan to Munich would be shortened by 100 miles and over.

A satisfactory progress is to be noted in the telegraph and telephone fields. In Paris, the telephone department is recovering from the effects of the disastrous fire at the main central exchange, so that it is too soon to expect much progress. However, matters are active in the way of running telephone lines so as to connect Paris with other cities. In concert with the German administration there is being run a direct line from Paris to Munich, and this will soon be in service. A line from Paris to Madrid has been decided upon. As there was no direct connection with Vienna except by way of Berlin, a new connection is to be made which will run by way of Frankfort. Between France and England is laid a telephone cable of a new type, and it runs from Gris Nez Cape to Dover. The French administration expects to lay a second cable of the same kind across the Channel before long. The recent telegraph and telephone congress held at Paris was of great interest. Mr. Carty's account of the telephone progress in America was of much value to European engineers.

The question has been agitated in Germany as to putting the whole of the 2,500-mile interurban telephone system underground. This would involve an outlay of $12,500,000. Professor Ebeling and also the Siemens-Halske firm claim that Pupin cables can be used without any special difficulty, and in fact there are already such cables working in the Westphalian region at present. The Italian government is taking measures to extend the telegraph lines consider-

ably and has voted a credit for this purpose. At St. Petersburg the telephone exchange will be increased so as to provide for 45,000 subscribers. Among the new lines in Russia we note the Tiflis-Baku line and another running from Theodosia to Kertsch. Long-distance experiments were made between Stockholm and Paris at 2,500 miles distance with the new Egner-Holmström transmitter with good results.

The most recent figures show that the United States is far in the lead with 6,620,000 subscribers. Germany has 880,000, England 590,000, France 197,000, Sweden 167,000, Russia 120,000, etc. Japan has 80,000 at present.

Wireless telegraphy and telephony has made very good progress during the last year. The underground high-power station at the Eiffel tower is nearly finished, and in it have been already installed special apparatus which send time signals to ships every twenty-four hours at midnight. Captain Ferrie has been sending signals very successfully to the Clement-Bayard airship, and experiments are also being made with aeroplanes. The warships *Justice* and *Verité* are equipped with wireless telephone apparatus on the Collin-Jeance arc system and trials will be made in the Mediterranean. Wireless telegraph apparatus are mounted on two submarines lying at Cherbourg harbor. We also note that the government post at Boulogne on the Channel coast using the Bellini-Tosi directed-wave system is in successful working. The principal companies for wireless work in France are the Ducretet, the Carpentier-Rochefort and the Compagnie Française.

In Germany the principal operations are carried on by the Telefunken Company. The Nauen plant is increasing its range and now covers 4,000 miles to vessels at sea. Measures are being taken at Berlin to connect with the African colonies and the Pacific possessions. The Zeppelin airship was used to exchange signals with the Nauen station, and this could be done for thirty miles. Among new apparatus, the Peukert and the Polyfrequency apparatus are attracting attention.

The Austrian navy has erected a large station at Pola on the Adriatic, which is one of the largest in Europe. It is able to reach the wireless posts in Germany and elsewhere. Near Madrid will be erected a 300-foot tower for a high-power plant, and a second post is to be located at Ceuta.

Various wireless control systems for torpedo or ship steering are being tried. The Gabet torpedo worked very successfully on the Seine near Paris. Dr. Branly is also engaged on this work in the Mediterranean and we should mention the Wirth-Knauss boat-steering system which was tried at Nuremberg. Among new detectors we note the new Tegon electrolytic detector and the Rossi "convector," also the recent experiments made at the Paris University by Professor Szilard.

There is an increased development to be noted in regard to iron and steel production by electric furnace plants. In the plant at Tinnfos, Norway, there is produced iron which is equal to the best Swedish iron at the rate of three tons per day, and the cost is but 0.6 of the latter. Steel is also produced for 100 francs a ton, where Swedish steel costs 250 francs. Hydroelectric power is used here. A Grönwall furnace plant of 2,500 horsepower is building at the Trolhättan hydroelectric plant, and it will be used for experiments upon various kinds of ore. Another furnace of the same kind, using 4,000 horsepower, has been constructed in Sweden. Next spring there will be opened the large iron and steel plant on the Hardongar, Norway, and it will have about 4,000 horsepower output. Tests which were made at the Domnarvfet plant show that the price of the iron will compete favorably with that of the blast-furnace iron. In France the Girod steel process is used at the Ugine plant, with thirty furnaces in operation, of the 300 to 800-horsepower size. The total capacity is 20,000 horsepower. A good part of the output consists of ferro-silicon, chromium, tungsten and other iron alloys. Another plant at Bonnay, France, uses 6,000 horsepower. The Girod process is also used at the Oehler works, Switzerland, the Cockerill in Belgium and the Becher and the Oberhausen works in Germany. High-grade steel is being produced by a Stassano furnace plant at St. Polten, Austria, and among others by the Hainault Metallurgical Company. In Italy there are a number of Stassano plants in operation at present.

Aluminum manufacture has increased much of late. One company is operating the Neuhausen works (4,000 horsepower) and the Rheinfelden plant (5,000 horsepower). It is to build two plants in the Rhone region, which will have 60,000 horsepower available for such work. In the Mt. Blanc region are a number of hydraulic plants belonging to French companies. Nine of these works have a total of 136,000 horsepower available. Aluminum is produced in the Pyrenees region at the Auzat works. Owing to the great increase in the French output it is thought that it now equals that of the United States and Canada.

Plants for the manufacture of nitrogenous products for fertilizing purposes are in operation in several countries. In the Scandinavian region the Birkeland and Eyde and the Schönherr processes are used. Part of the great Rjukan 140,000-horsepower hydroelectric plant is to be employed for both these processes. The Pauling process is gaining ground, and it is used both in Austria and in France. Two of these plants have 10,000 horsepower each. Cyanamide is manufactured at the rate of ten tons daily at a plant on the Belleville stream, France, using 11,000 horsepower in all. Other works for this product are situated at Martigny, Switzerland, Piano d'Orte, Italy, and other places.

Review of Electrical Patents of the Year 1910.

BY EDWARD E. CLEMENT.

The patents issued in any particular year are not in all cases correct indices of prevailing conditions in the arts to which they belong. In general, however, there is a relation between the current issues and the trend of development, which can be readily followed. For example, the Welsbach osmium filaments were invented prior to 1898 and applications filed in that year; but the patents were not issued until a practicable filament was actually developed and the market prepared to receive it. Thus the issue of the Welsbach patents this year is, in fact, an indication of the present stage of development, and so with many others.

It would be impossible to make com-

plete figures at the present time showing all the current development of electricity in the arts, because electricity is now as common as chemistry, its application being practically universal. However, we have in the Patent Office a very sharply defined and well arranged classification of the patents relating to distinctly electrical inventions. Of these there were 2,148 issued during the year 1910, divided as follows: Generation, 235; lighting, 288; signaling, 95; telegraphy, 163; telephony, 250; electric railways, 110; motive power, 226; conductors and insulators, 125; heating and rheostats, 124; electrochemistry, 210; medical and surgical, 7; general applications, 315.

Judging from this distribution, the most active classes this year have been generation (which includes generators, meters, regulators, transformers, etc.); lighting and telephony, with electrochemistry a close fourth. The number of patents in all the classes, however, shows to a certainty that our rate of development is still increasing, and that professional effort in this direction is being fairly well distributed.

A better idea of the work that has actually been done can be obtained by briefly reviewing the subclasses under each of the general classes. Taking these in the order in which they are named, we find the following distribution:

1.—Generation.—Meters, 15; magneto-electric generators and parts, 99; transformers and induction coils, 17; regulators, 39; systems of distribution, 57.

2.—Lighting.—Incandescent lamps, 20; systems, 5; sockets and keys, 113; arc lamps, 38; special features (details), 22; systems, display, 13; X-ray apparatus, 8; mercury and other vapor lamps, 39; incandescing compositions, 30.

3.—Signaling.—Bells, 10; circuit closers, 32; burglar and other alarms, 20; annunciators and annunciator systems, 39.

4.—Telegraphy. — Condensers, 5; keys, 3; repeaters, 3; circuits and systems, 11; relays, 15; sounders, 2; fire-alarm systems, 35; reed telegraphs, 3; printing telegraphs, 7; multiplex, 1; quadruplex, 1; transmitters and miscellaneous, 10; autographic, 2; wireless, 65.

5.—Telephony.—Antiseptic protectors, 18; systems (circuits), 126; switchboards, 13; telephone sets (instrument equipment), 83; relays and repeaters, 9; testing devices, 1.

6.—Electric Railways.—Electric railway systems, 47; supports and insulators, 25; telpher and towing, 2; trolleys, 29; railways, general, 5; locomotives, 2.

7.—Motive Power.—Steering and propulsion, 4; motors, 196; transmission of power, 28.

8.—Conductors and Insulators.—Conductors, 73; rail bonds, 7; connectors, 4; insulators, 41.

9.—Heating and Rheostats.—Heaters, 79; metal heating and working, 19; rheostats, 7; resistance elements, 19.

10.—Electrochemistry.— Electrolysis (including apparatus and processes), 89; secondary batteries, 47; primary batteries, 24; synthesis and ozone, 22; carbides, 9; reduction, 14; electric furnaces, 62.

11.—Medical and Surgical, 7.

12.—General Applications.—Electromagnets, 16; lightning arresters, 27; igniting devices, 25; circuit-breakers, 28; cut-outs, 65; switches, 140; systems, safety, 12; special applications, 2.

It will be observed that the most active subclass in the entire art is that of motors, with 196 patents under it. Of course this includes motors of every type, for both alternating and direct current. A closer analysis shows that of these 56 were alternating-current motors, 31 of direct-current type, 96 patents relate to "hand-operating devices" for motors, and 26 relate particularly to special designs for elevators.

The development in generation, railways and, in fact, in all of the other classes except telephony, has been normal and general. There is more or less concentration shown in telegraphy on the subject of wireless, or wave-transmission systems, but this condition has prevailed for several years, and will probably continue until the art is fully developed. Reference will be made hereinafter to some of the important patents, which show that while no broadly new principles have been discovered, highly superior work is being done. In telephony, on the other hand, there has been an unusual stimulus since the beginning of the year, and in fact for several years; and this stimulus will probably continue until the application of automatic mechanism to switchboards and instruments has reached a much higher stage than at present. The patents listed above under "Telephone Systems" include among others the following:

Composite systems, 5; composite fire and police systems, 7; muliplex systems, 1; automatic systems (of which four use a percentage switching scheme), 5.

Among the other systems are 28 party-line schemes, of which six involve lockouts, to prevent listening-in. There are also ten intercommunicating systems, showing that there is still a demand for this type. These include not only house systems segregated from an exchange, but also those in which each station in a building or district can call any other by local means, and any one can be connected to a central office trunk for incoming or outgoing calls. This will be the ultimate arrangement adopted in all exchange systems, and in fact is no more than a reversion to the old "village system" schemed out by Thomas D. Lockwood and his associates in the very early days.

The subject matter and scope of some of the patents issued this year are even more significant, and of greater importance, than the numbers. It will be worth while to glance at a few of these, taking them by classes as they come, with the understanding that in presenting them I do so only as interesting examples, the limitations of space forbidding an exhaustive study at this time.

On November 22, 1910, there were issued to the Welsbach Light Company, of New Jersey, as assignee of Carl Auer von Welsbach, of Vienna, four patents for the manufacture of electric filaments Nos. 976,526, 976,527, 976,528 and 976,616. All four applications were filed on the same day, August 9, 1898, hence they were pending for more than twelve years. The significance of their issue at this time will be understood when it is stated that they have broad claims which may affect the present metallic-filament art.

For example, in No. 976,527 the following claims are found:

"4. The herein described method of manufacturing a metallic electric filament, consisting in associating organic thread with metal having a higher point of fusion than that of platinum, and, subjecting the same to dry distillation, and placing the same in a suitable atmosphere wherein the carbon is eliminated, and by the action of the electric current at a temperature at which platinum would volatilize, causing the metallic particles to unite into a dense, compact, coherent filament suitable for

electric incandescence; substantially as set forth."

"5. A dense, coherent metallic filament for incandescent electric lamps, consisting of metallic particles fritted together and which incandesces at a temperature above that at which platinum volatilizes; substantially as set forth."

Again in No. 976,526 occurs this claim:

"15. The process of making filaments for incandescent electric lamps, which consists in producing a thread-like body of loosely-coherent metallic particles, and then progressively raising the temperature of said body to dazzling incandescence, by the passage therethrough of an electric current until said particles are united into a compact, coherent elastic filament; substantially as described."

In 976,528 we find the following among others:

"6. An incandescent electric lamp having a metallic filament connected to its leading-in wires by a body or bodies the metallic base of which is substantially the same as the metallic base of the filament."

"7. An incandescent electric lamp, having a metallic filament, and leading-in wires, the incandescing temperature of the filament being beyond that at which the metal of the leading-in wires would fuse, and a connecting metallic fuse-joint uniting the filament and leading-in wires, the metal of the fuse-joint being substantially the same as the metal of the filament."

In 976,616 the following occurs:

"8. The herein described process of forming an incandescent filament for an electric lamp, consisting in depositing intermittently upon a fillet a series of layers of a metal infusible at the temperature at which platinum volatilizes, and uniting the several layers into a compact and coherent, flexible, elastic filament by raising it above said temperature, substantially as set forth.

The material which von Welsbach discovered and actually used for his filaments in 1898 was osmium. He found that this metal when pure could withstand without melting or volatilizing a temperature above the volatilizing temperature of platinum if placed in *vacuo* or certain protective gases, and therefore that it could be raised to a temperature such that the light emission would bear a high ratio to the consumption of energy. He had the same difficulties to overcome which are met in dealing with all of this group of infusible metals. In carrying out his invention he made a stiff paste of osmium or its salts, with a syrup of sugar or viscous collodion. This was forced through a die to form the filaments, and then subjected to a dry or destructive distillation. The carbon was then removed by subjecting the incomplete filament to the influence of a moderate heat in an atmosphere of gases capable of taking up the carbon without oxidizing the osmium, and the osmium particles were finally fused or cemented together by continuing the current to the development of a heat at which platinum would volatilize.

The issue of these patents is in the nature of a surprise, but their effect is likely to be limited to the manufacturers.

Under electric signaling there have been very few patents of note. Of passing interest are Nos. 949,322 and 953,243, both covering alternating-current, block-signal systems. The first issued to the General Electric Company, as assignee of L. A. Hawkins, and the second to the Union Switch & Signal Company, as the assignee of Per Utne. In the Hawkins patent the signals at both ends of the block are controlled by a single relay of wattmeter type worked through transformers connected across the block sections. In the Utne patent transformers are also employed, but in a different relation. The rails are cross-bonded at the ends of the blocks, through bonds having low ohmic resistance and impedence; alternating-current leads are connected through a transformer bridged across the middle of each block section, and other transformers are connected to the rails at the ends of the blocks, laminations associated therewith "affording a path for the magnetic flux produced by the signaling current flowing in the track rails and windings in which a current is induced." This current affects relays which control semaphores.

Under telegraphy, the subclass of wireless, it will be noted, has been most active. In this class some of the patents are very interesting, and will well repay reading, although only brief mention can be accorded them here. Among others Mr. Marconi was granted patent No. 954,641, April 12, 1910, for a duplex scheme. It has before been suggested to connect the aerial to the transmitting and to the receiving circuits respectively for small portions of a second alternately and successively, but with such an arrangement it is necessary to synchronize the instruments at the two stations to render the transmitter operative at one station, while the receiver is operative at the other, and vice versa. Mr. Marconi in the present case avoids the necessity for synchronism, which is difficult to obtain in practice, by providing at each of the stations transmitting and receiving apparatus which are rendered operative and inoperative alternately to each other in rapid succession, the transmitting periods being considerably shorter than those of the receiving periods, while the making of each sign by the transmitter occupies several operative periods, which do not synchronize with those of the apparatus at any other station. The apparatus for practicing the invention includes one or more commutators rotated synchronously with the studded wheel which causes the groups of electrical oscillations to be generated, in such a way that the receiving apparatus is rendered operative only during intervals between discharges. This patent is assigned to the Marconi Wireless Telegraph Company.

A second very interesting and very ably presented invention is that of John Stone Stone, in patent No. 961,265, granted June 14, 1910. The purpose is to determine the direction of space telegraph signals without changing the position of the elevated receiving conductors relatively to the direction of motion of the electromagnetic waves (which was necessary in a previous system of Mr. Stone's covered by patent No. 716,135, December 16, 1902). To practice the invention he employs two separated elevated receiving conductors, of which the separation bears no relation to the length of the wave to be received, and an electrical system which he calls "an artificial line" associated with one or both of the receiving circuits, so that by suitable adjustment of the connections of an oscillation detector with respect to one or both of the artificial lines, the resistance of the detector to the oscillations developed in the aerials will be reduced to a minimum or rendered zero. Among his diagrams he illustrates a ship provided with two antennæ, presumably attached to the masts, and in the specification he gives a somewhat extended mathematical demonstration.

A third wireless patent to be noted is that granted Reginald A. Fessenden, No. 962,017, June 21, 1910, for a galvanometric instrument having coils of what he calls "microscopic and microbaric" dimensions, because as a rule they are best wound under a microscope. As compared with a coil of an ordinary Thompson galvanometer, which is usually about four inches in diameter and one inch in thickness, the relative volumes of these coils are in the ratio of one to one million, the Fessenden coil having a diameter of about four one-hundredths of an inch, and a

thickness of about one one-hundredth of an inch. He claims that the magnetic effects are concentrated to such a degree that the effect of self-induction is considerably greater than that due to ohmic resistance, and hence the coils act very efficiently and are capable of sharp tuning. Among the advantages claimed are much greater intensity of magnetism than possible with a permanent magnet; much greater current-carrying capacity without undue heating, and that the amount of movement taking place in a given time decreases with a very high power of the diameter of the wire used, and that by halving the size of the wire, the movement taking place in a given time may be increased more than one hundred times. He uses laminated iron wire in the cores, one one-thousandth of an inch in diameter.

An interesting relay patent is No. 953,361, granted March 29, 1910, to the General Electric Company as assignee of John B. Taylor. Mr. Taylor presents a mercury-vapor tube with two anodes and a cathode and an electromagnet whose poles are arranged to produce a flux across the mercury arc between the anodes and cathode, so that by varying the energizing current of the magnet the flux will be varied and a corresponding variation will be produced in a receiving instrument connected across the anodes.

In telephony it should be noted that eighteen patents were granted for antiseptic protectors, that is, devices for sterilizing mouthpieces. This shows that electrical inventors have not entirely lost sight of the public health and morals. It is also worthy of note that seven repeaters have been patented, and two telephonic relays.

The really important patents in this class unfortunately are too voluminous, and their subject matter too complicated for really intelligent explanation in a brief space. They should be read carefully by those interested. No. 949,836, February 22, 1910, was granted to the Western Electric Company as the assignee of McQuarrie & Craft, for a type of automatic selector switchboard radically different from those in common use. The multiple line terminals for a number of individual selectors are assembled in a large flat-faced bank or panel over which contact brushes are carried by vertical slide rods, which form the movable switch members of the individual selectors and are mounted closely together along the horizontal width of the board, to traverse corresponding rows of terminals. Each rod is connected by a flexible support such as a cord or metal ribbon to an individual self-contained selectively operated lift connector mounted at the top of the panel. The selector magnets do light work, serving merely to adjust a stop-setting apparatus, after which motive power is applied by a magnetic clutch to carry the movable switch bar directly to the point thus determined, when the clutch is automatically thrown off.

Patent to Stevens, No. 957,909, May 17, 1910, presents a completely worked out automatic system for use in small centers, or private systems, having for example not to exceed one hundred subscribers' lines. A rotary type of switch is employed, and when lines are connected a standard bridged common-battery circuit is produced. Another one of the newer types of systems, which constitute a departure from the classic Strowger arrangement, is worked out in detail with register and other attachments in patents to the Kellogg Switchboard & Supply Company, assignee of A. H. Dyson, Nos. 958,863 and 974,866. The selective switch shown in the former patent is particularly interesting, having been designed for Mr. Milo G. Kellogg as an improvement over the Strowger switch. It is a two-motion switch, with ten rows of ten contacts each, but these rows are curved and instead of a straight motion and a rotary motion, the spindle carries wipers which rotate in both directions, both to select the row desired, and to sweep over the contacts in that row.

In the semi-automatic field, the carrying forward of the selection of idle cords, so as to combine therewith a master switch controlling a line-finder switch, is shown in another patent to Dyson, No. 975,338, November 8, 1910, assigned to the Kellogg Switchboard & Supply Company. Also, in systems of this general character, some interesting features, including control for sending purposes of a power-driven impulse machine with keyboard, are found in the patent to Wright, 965,976, August 2, 1910, assigned to the North Electric Company.

Under motive power, patents to be noted are those to Alexanderson, assignor to the General Electric Company, No. 967,295, dated August 16, 1910, and Lamme, assignor to the Westinghouse Electric & Manufacturing Company, No. 977,641, December 6, 1910. These inventors were in interference on the broad idea involved, which is supposed for the first time to render available the use of regenerative control in alternating-current work. The idea is the excitation of the motor when operated as a braking generator in such manner that the generated electromotive-force will be substantially in phase with the line electromotive-force. This much is disclosed in both patents. Alexanderson goes a step farther, and regulates the phase of the generated electromotive-force so that it will be in phase with the line current.

Patent No. 977,821, December 6, 1910, granted to the General Electric Company, assignee of Maurice Milch, covers an alternating-current commutator machine having means for neutralizing the sparking electromotive-force in a short-circuited coil. Auxiliary commutating fields are disposed in the axis of the brushes, with means for regulating the phase and the strength of the current energizing the auxiliary field coils.

Under electric heating and rheostats, an interesting patent was issued to John T. Irwin, of London, England, July 19, 1910, No. 964,521. The invention is a hot-wire measuring instrument, and if successful in practice should make hot-wire meters available in high-frequency current work. Heretofore it has been difficult to observe and measure accurately the instantaneous current or rapid variations in current by means of the heating and cooling of wires for three reasons: (1) The deflection of a hot-wire instrument is proportional practically to the square of the current passing through it. (2) The deflection is in the same direction for both directions of current flow. (3) Owing to the heat capacity of its strips or wires the instrument takes some time to attain its normal deflection after a given current is switched off. Mr. Irwin obviates objections (1) and (2) by polarizing the wires from a continuous-current supply when it is desired to measure the instantaneous electric pressure or current. The effect in this is either summation or subtraction, and the deflection becomes proportional to the current, instead of to its square. To overcome point 2 he compensates for the heat capacity of

the wires by means of condensers or inductive resistances, when measuring the instantaneous current, pressure or power. By way of apparatus, Mr. Irwin describes two wires of the same material and resistance joined together at one end, with a source of constant continuous current connected to the junction. When another current is led through the two strips in series, the rate of heating in one wire is equal to $(a-b)^2r$, and in the other wire $(a+b)^2r$. The difference in the rate of heating will equal $4abr$, where b is the value of the constant continuous current in each strip, a the current sent through them in series, and r the resistance of each strip. The difference in the heating of the two strips will produce a difference in their lengths proportional after a short time to $4abr$. By observing the variation in length, the current a may be measured.

Under electrochemistry, almost all of the new patents are worth reading, because the nature of the art is such that frivolous persons and frivolous inventions have no place in it. Typical patents in the different branches of the art might be selected as follows: 944,822, 946,540, 954,080, 960,115, 961,912, 962,013, 963,980, 966,025, 969,261, 972,779, 972,947, 974,633, 974,741, 974,742, 975,571, 975,794, 976,002, 976,092. These cover generally the field of storage batteries, processes for the production of hydrocyanic acid and other substances, furnaces, thermic batteries, glass retorts, etc.

Among the storage-battery patents is No. 946,540, granted to Thomas A. Edison, assignor to the Edison Storage Battery Company, January 18, 1910, for an improvement in his nickel-iron battery.

One group of special interest are the two DeFerranti patents, Nos. 962,013 and 969,261, and the patent to Potter, assignor to George Westinghouse, granted November 15, 1910, No. 975,571. These all relate to furnaces in which a molten charge of metal is rotated or mixed by means of a rotating magnetic field. The second claim of the Potter patent reads as follows: "The method of stirring highly heated, fused conducting material, which consists in maintaining an alternating rotating magnetic field in inducing relation thereto." It is claimed that the processes disclosed in this group of patents will materially affect the cost of steel production.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

MEETING OF THE ASSOCIATION AND AFFILIATED SOCIETIES AT MINNEAPOLIS.

The sixty-second meeting of the American Association for the Advancement of Science and affiliated societies was held in Minneapolis, December 27 to 31. The meeting was inaugurated by a general session on the evening of Tuesday, December 27, at which the retiring president, David Starr Jordan, made an address on the subject, "The Making of a Darwin." In this address President Jordan drew a contrast between the conditions existing in university life at the present time and those which helped to develop the genius of Darwin. He did not seem to consider such a development possible today, when university work is too much like machine output and there is not sufficient inspiration from great teachers. Our courses of study are too extensive and not sufficiently intensive.

The meetings of the various sections were begun on Wednesday morning. The Section of Mechanical Science and Engineering was concerned with a number of papers on general engineering and with a special session devoted to aeronautics. Most of the papers dealing with electrical subjects came before the joint meeting of the Physical Section and the American Physical Society.

The addresses of the vice-presidents of the Physical and Engineering Sections were given at a joint meeting on Thursday afternoon. The address of L. A. Bauer of the Physical Section was entitled, "The Broader Aspects of Research in Terrestial Magnetism." This paper dealt with some of the disturbances of the earth's field which have been observed, and with the possible causes of these disturbances and of the earth's field itself. We cannot hope to ascertain the latter until the former have been discovered.

The address of John F. Hayford of the Section of Mechanical Science and Engineering dealt with problems in geodesy in relation to geology and geophysics.

At the close of this session B. L. Newkirk and W. E. Brooke gave an experimental demonstration of a monorail car, which was balanced by means of gyroscopic action.

At the meeting of the Physical Section on Wednesday morning, one of the papers read was by F. C. Brown on "The Nature of the Recovery of Light-Positive and Light-Negative Selenium."

THE NATURE OF SELENIUM.

This paper dealt with the various behaviors of selenium as manifested in cells of the Giltay, Bidwell-Ruhmer, Ries and the light-negative types. The behavior of these cells has been further studied since the presentation of a paper by the same author, which was abstracted in our issue of December 10, and the author concludes that of the three forms in which selenium exists, designated as A, B and C, only the B variety takes part in conduction, and the conductivity depends upon the amount of this variety present. All cases can be fully explained by assuming appropriate values for the A, B and C constituents.

At the afternoon session a paper by C. E. Mendenhall and W. E. Forsythe, entitled, "The Light-Emission of Tungsten, Tantalum and Carbon as a Function of Their True Temperature," was presented by Professor Mendenhall.

RADIATION AND TEMPERATURE OF CARBON AND METALS.

This work consisted in the measurement of the true temperature and of the black-body temperature of tungsten, tantalum and carbon such as is used in incandescent lamps. By the black-body temperature is meant the temperature which a black or perfectly radiating body would have when emitting radiation which produces the same effect in an optical pyrometer as is given by the object under test. The results show that the normal working temperature of a carbon filament is about 1,950 degrees centigrade, of tantalum 2,025 degrees, and of tungsten 2,300 degrees. The true temperature of carbon is the nearest to its black-body temperature, tantalum is further off and tungsten differs most from the black-body. That is to say, the relative selectivity is in the order given. Curves plotted between true temperatures and black-body temperatures were very nearly straight lines.

The next paper, by E. B. Rosa and E. C. Crittenden, entitled, "The Pentane Lamp as a Primary Light Standard," was presented by Dr. Rosa.

PENTANE LAMP AS A STANDARD.

This paper describes a continuation of the work reported at the Baltimore Convention of the Illuminating Engineering Society, and abstracted in our issue of November 5. The latest experiments have been along two lines—first, to ascertain the source of the differences in the candlepower of different pentane lamps, which amount to from one to five per cent, and second, to study the performance of a new type of pentane lamp devised by themselves. (1) Pentane lamps by the same maker differ from one to two per cent, and pentane lamps made by different makers differ still more. Apart from any variations due to differences in the fuel used in the lamp, or differences in the atmospheric conditions under which the lamp is used, the principal sources of difference are in the burners and in the supply of air to the interior of the circular burner. The specifications for the steatite burner of a pentane lamp require that there shall be thirty holes in a ring, each hole being from 1.25 to 1.50 millimeters in diameter, and the holes drilled in a burner with internal and external diameters of 14 and 24 millimeters. It is found that the burners made by different manufacturers of pentane lamps differ both with respect to the size of the holes used and the diameter of the circle of holes,

and that this difference causes an appreciable difference in the candlepower of the lamps. In other words, the specifications are not sufficiently precise with respect to the burner, the latitude which is possible while conforming to the specifications being too great. With respect to the air circuit, there are several differences in the manufacture which affect the temperature of the air in different parts of this circuit, and therefore the strength of the draft. American-made lamps having usually a weaker draft and giving somewhat lower candlepower than the English lamps. In order to ascertain the source of the differences between English lamps of different makes, the chimney, saturator and air tubes of one lamp were replaced by those of another maker, the base of the lamp and the burner remaining. This exchange of parts between the lamps of two makers gave a candlepower intermediate in value between the candlepower of the two lamps used, showing that the difference was partly in the burner and partly from the air circuit in the chimney. The lamps are so built that it is impossible to take them apart further without permanent injury to the lamps. Hence a more minute study of the source of differences was not possible. The Bureau of Standards ordered from an American manufacturer of pentane lamps a special lamp, in which the parts were to be put together loosely so that any part could be replaced by a new piece, and experiments were made upon this lamp to ascertain the effect of variations in the dimensions. In this way it was found that the lower candlepower of the American lamp was due chiefly to two sources, which may be easily remedied and the candlepower made more nearly equal to ten candles. As the candlepower is easily affected by variations in the draft, and the draft is affected by air currents in the region surrounding the lamp, it is necessary that the lamp be very carefully screened while in use.

(2) The authors have constructed a new type of pentane lamp, in which the draft is produced by heating the air by means of an electric current, the object being to secure, if possible, a more constant draft, and thereby eliminate one source of variation in the lamp. They have also used an electric current to vaporize the pentane instead of having it vaporized in a saturator, as is done in the Harcourt lamp. This new lamp is constructed so that any part can be replaced by another, and in that way the variation of the candlepower, due to slight variations in each particular element of the lamp, can be studied. The new lamp gives ten candles, and operates very well, but is not yet perfected. The pentane lamp when used as a secondary standard need not necessarily have exactly ten candles, and need not necessarily be like all other pentane lamps. The principal requirement is that it shall be consistent with itself from time to time. The requirements for a primary standard, on the other hand, are very different. If the candlepower is to be ten candles under normal atmospheric conditions, and any pentane lamp is to be taken as having the same candlepower as every other primary pentane lamp, then it is necessary that every element of the lamp which affects the candlepower shall be very accurately standardized and the parts be interchangeable, that is to say, it should be possible to assemble such a standard lamp from standardized parts and get the same candlepower, no matter by whom the parts were made or where the lamp is used. This is a requirement never yet met by pentane lamps with the accuracy required of a primary standard. The experiments at the Bureau of Standards will be continued with a view of learning, if possible, the best construction and the best method of operation of a pentane lamp for the purpose of a primary standard

In the discussion of this paper C. E. Mendenhall inquired whether a more nearly ideal primary standard of light could not be obtained by keeping some definite radiating substance at a constant temperature.

E. L. Nichols pointed out that the difficulties found in the use of the pentane lamp were the same that had troubled observers fifty years ago with the Carcel lamp.

H. E. Ives referred to the proposal of Steinmetz that a standard of light might be obtained by radiating a definite amount of energy from a particular substance, a definite line in whose spectrum was utilized as a source.

G. W. Stewart called attention to the fact that the temperature varies in different parts of a flame and the effects obtained in the pentane lamp were due to the average temperature.

In reply Dr. Rosa stated that the flame was used in the condition in which it gave out the maximum light and consequently slight variations on one side or the other of an exact adjustment of the flame produced very little error. While this standard is not so ideal as some others that might be suggested, it was the most feasible one at the present time and with proper specifications was reproducible with the necessary accuracy.

The next paper was by S. R. Williams and was entitled, "Experimental Indications of the Nature of Magnetism."

THE NATURE OF MAGNETISM.

A study of magnetostriction in steel tubes, that is, the change in length due to a longitudinal magnetic field, has led to a hypothesis as to the nature of a magnetic substance. The fact that an iron rod first lengthens and then shortens, as the exterior magnetic field is increased, leads to the idea of a mechanical orientation of particles inside of the iron, these particles having dimensions differing in various azimuths. The magnetic atoms are conceived as oblate spheriods which are the positive nuclei, to each of which are attached one or more negative electrons, which are revolving about or in the positive nucleus in the equatorial plane. The author prefers to think of this model as patterned after one of the planets, a central nucleus, flattened at the poles, and with several attendant satellites. The property of permeability is dependent upon the nature of the positive nuclei. If there are no other forces acting at the same time, these ellipsoidal nuclei will orient themselves in the external magnetic field in such a way that the magnetic resistance is a minimum. For ferromagnetic substances the equatorial planes of the ellipsoidal particles would be parallel to the direction of the imposed magnetic field. But the nuclei have no permanent polarity remaining on the removal of the external magnetic field. The electrons which are revolving about the nuclei, will, due to the magnetic field produced by their motion, seek to turn their planes of revolution normal to the external magnetic field. Hence if these planes of revolution of the negative particles are fixed with respect to the equatorial planes of the nuclei there will be two forces acting upon the magnetic atoms, tending to orient them in definite directions, when introduced into a magnetic field. For weak magnetic fields a bar of iron lengthens, but as the field is increased the bar contracts until it attains a certain constant value. In weak fields the equatorial force is predominant and the nuclei turn with major axes parallel to the external field; this produces lengthening. An increase of external field causes the axial force to become predominant and nuclei turn with minor axes parallel to the external field. This produces shortening. Such a change in length, if the theory is correct, must be accompanied by a transverse effect, which is the case. Nickel rods contract in a magnetic field. The equatorial force is not sufficient to orient the nuclei, therefore only the axial force is operative. The Wiedemann effect; or twist of an iron rod due to the superposition of a circular and longitudinal magnetic field upon the magnetic substance is also explained. Smith discovered that a rod of iron twisted due to a longitudinal field alone. This theory shows this to be expected in substances showing permanent magnetism. Soft iron wires show scarcely any twist; hard steel, maximum values of twist. This theory also accounts for the behavior of certain crystals in a magnetic field, which Farady, Tyndall, Plücker and others have described as magnecrystallic action.

In the discussion, M. G. Lloyd pointed out that Ewing's theory explained the phenomena of varying permeability in gross bodies, and what is needed is an explanation of the existence of the polarized elemental magnets. The electron theory is an advance insofar as it reduces the phenomenon to a purely electrical one. The present hypothesis raises a new difficulty by assuming a nucleus which is polarized independently of the revolving electrons. While the shape assumed for the elemental magnets may assist in explaining some of the phenomena of magnetostriction, it does not explain the change of volume, nor even the length change of certain substances. As an example of the latter, K. E. Guthe mentioned Heusler alloy. Professor Taylor spoke in the same vein.

L. A. Bauer spoke of certain aspects of the electron theory, particularly the work of Birkeland, Langevin and J. J. Thomson. E. M. Wellisch also spoke of the latter.

The session of the Physical Section on Thursday morning was devoted to some papers of general interest. These were "Recent Advances in Phosphorescence and Fluorescence," by Edward L. Nichols; "The Isolation of Ions," by R. A. Millikan; "The International Electrical Units," by E. B. Rosa; "The Osborne-Reynolds Theory of Gravitation," by John Mackenzie.

The address by Professor Nichols was a collection of some of the more important data on the subject, and an

account of some of his own work in this line, especially with respect to the effects of low temperature.

The address of Professor Millikan covered in the main the same ground as his paper on this subject, which was abstracted in our issue of October 22 last. The latest value assigned to the elementary quantity of electricity is, however, 4.897×10^{-10} C. G. S. electrostatic units. The discordant results obtained by some other observers were explained and the bearing of his work upon the accuracy of the law of Stokes, the kinetic theory of gases and the theory of X-rays was pointed out.

The paper by Mr. Mackenzie gave some of the details of a theory of gravitation and was illustrated by interesting experiments, and at a later meeting another theory on this subject was presented by Charles F. Brush.

The address of Dr. Rosa included the announcement of changes which are being made in the electrical standards of the Bureau of Standards, and an abstract is given below.

CHANGES IN ELECTRICAL STANDARDS.

At the London conference on electrical standards in 1908, it was decided that the ohm and ampere should be the fundamental units and these were concretely defined. The value of the volt was to be determined from these and thus fix the value of the Weston cell, which was adopted as a working standard. The realization of these definitions in different national laboratories results in slight discrepancies but a meeting of representatives of the national standardizing laboratories in Washington last spring agreed upon the adjustment of these and upon specifications for the silver coulometer and for the standard cell. As a result of this work there has been an international agreement to assign the value 1.01830 volts to the cadmium saturated cell at a temperature of twenty degrees centigrade. The values heretofore used have been as follows: United States Bureau of Standards, 1.0191; English National Physical Laboratory, 1.0184; German Reichsanstalt, 1.0186. The result of this action is to increase the value of the standards representing the volt and ampere at the Bureau of Standards by 0.08 per cent. The value of the watt which is derived from these two units is therefore increased by 0.16 per cent, an amount which is quite appreciable in indicating instruments.

At the meeting of the American Physical Society on Friday a number of papers were presented of electrical interest. The first of these was by Henry A. Erikson, entitled "The Coefficient of Recombination of Ions in Carbon Dioxide and Hydrogen." It was shown that this coefficient increased as the temperature is lowered.

The next paper, by Anthony Zeleny, was entitled "The Causes of Zero Displacement and Deflection Hysteresis in Moving-Coil Galvanometers."

ZERO DISPLACEMENT IN GALVANOMETERS.

This is a continuation of previous investigation, showing the zero displacement in moving-coil galvanometers to be due almost entirely to the magnetic impurities within the coil. The largest true set observed produced only five per cent of the whole zero displacement. The thinner suspensions give the smaller true set. The hysteresis curve for the magnetic impurities shows a sufficient coercive power to account for the observed deflection hysteresis. The upper bend of the cuve is in a field intensity of about 1,600, which is large compared to the corresponding intensity for iron or steel. The relation of the zero displacement to the magnitude of the reversed deflection and the change of the zero reading with time were investigated. More than two-thirds of the damping on open circuit was found for ordinary galvanometers, to be due to the resistance of the air and the internal friction of the fiber, and less than one-third to the induced currents.

The next paper, by M. G. Lloyd, was entitled "Effect of Wave Form Upon Incandescent Lamps."

EFFECT OF WAVE FORM UPON INCANDESCENT LAMPS.

It is shown on theoretical grounds that the power consumption, the candlepower and the life of incandescent lamps depends upon the wave form of the current or voltage used to operate them. The magnitude of the effect depends upon the heat capacity of the filament and upon the frequency, as well as upon the wave form. A typical case chosen for illustration was between sinusoidal alternating current and continuous current. With metal filaments the power consumed is less with alternating current, while with carbon it is greater. In both cases, however, the candlepower is greater with alternating current, and the life is shorter. Experimental investigation indicates that at frequencies of sixty cycles or higher the effects will not be appreciable with commercial lamps, and even at twenty-five cycles the heat capacity of carbon is sufficiently high to prevent observable effects. With a twenty-five-watt, 120-volt tungsten lamp at twenty-five cycles, the power consumption was found to be 0.16 per cent less with alternating current than with direct current, whereas the candlepower was 1.6 per cent greater. This paper will be published in full in a future issue.

In the discussion A. G. Worthing stated that a difference in candlepower of from 0.5 to 1.0 per cent had been found at the Physical Laboratory of the National Electric Lamp Association for a tungsten lamp when operated on direct current and on alternating current of twenty-five cycles. A. H. Taylor called attention to the fact that a similar effect would be obtained in the alternating-current-direct-current comparator, which is sometimes used as a standard instrument for measuring alternating currents.

A paper by Anthony Zeleny on "The Temperature Coefficients of the Free and Absorbed Charges in Electric Condensers" is abstracted below.

TEMPERATURE COEFFICIENTS OF CONDENSERS.

The discharge curves of several mica and paper condensers were obtained at different temperatures. From these the temperature coefficients were obtained for various periods of discharge. The results are shown in the following table, where "true" capacity is measured by the free charge and the effective capacities are represented by the respective periods of discharge:

	Temperature Coefficients.			
Effective Capacity.	Paper No. 1.	Paper No. 2	Mica No. 3.	Mica No. 8.
True	0.00050	0.00006	0.00023	—0.00117
0.01 second....	0.00071	0.00008	0.00025	—0.00121
0.08 second....	0.00171	0.00040	0.00042	—0.00220
3.08 seconds...	0.00842	0.00234	0.00089	—0.00748

The temperature coefficients of the absorbed charges alone, liberated during the first three seconds, varied from 0.04 to 0.16 in the different condensers, and are large compared to the temperature coefficients of the true capacities. The temperature coefficient of a condenser is shown to be a fixed quantity only for a particular method of employment.

In the discussion E. B. Rosa pointed out that mica condensers ordinarily have a dielectric composed partly of mica, which has a small positive temperature coefficient, and partly of paraffin, which has a high negative temperature coefficient. The resultant may consequently be either positive or negative, and in good condensers where the paraffin has been largely squeezed out the temperature coefficient is close to zero. When paper condensers are heated to a temperature approaching the melting point of paraffin, a storage-battery action sets in and as a result the temperature coefficient apparently assumes an enormous value. In general, both the capacity and the temperature coefficient of a condenser depend upon how it is used and the value should be determined for the particular manner of use.

The afternoon session opened with a paper by F. C. Brown and W. H. Clark entitled "A Method of Measuring the Fluctuations in a Rapidly Varying Resistance."

MEASURING A RAPIDLY VARYING RESISTANCE.

Sometimes it becomes necessary to measure a variable resistance which changes during short intervals of time. The authors find by placing the variable resistance in one arm of a Wheatstone bridge its average value for the interval can be expressed in terms of the throw of a ballistic galvanometer. The galvanometer is thrown into the circut, by means of a pendulum, for a short interval of time. How small this interval should be is determined by the rapidity with which the resistance changes. If it is made sufficiently small the average resistance is the actual resistance at the middle of the interval.

The quantity of electricity passing through the galvanometer during the short interval of time depends upon the value of the variable resistance in one arm of the Wheatstone bridge. The constant of the galvanometer may be determined by any one of several methods, as by throwing the bridge out of balance by a known amount.

If the amount by which the resistance differs from the valve that balances the bridge is constant, the deflection is propor-

tional to the time. If the time is kept constant, the deflection varies as the change in resistance. Experimentally these conclusions were verified by an experiment, the apparatus of which was connected as shown in Fig. 1. The pendulum and keys were similar to those described in Carhart and Patterson's "Electrical Measurements," a, b, R and x are standard resistances, B is a battery of known electromotive force, G is the galvanometer. Keys k_1 and k_2 are operated by the pendulum and throw the galvanometer in and out of the circuit. In the first place the bridge is thrown out of balance by a constant quantity, and the time is varied. By adjusting the position of keys k_1 and k_2 the time may be made to vary from 0.002 to 0.4 seconds. With the resistance kept constant, galvanometer deflections were read for small increments of time ranging between the values. Curves were plotted using deflections as ordinates and time as abscissas. Three galvanometers of different periods were used, all of which gave data for curves of the same general form. Then the resistance was varied, while the time-interval was kept constant, giving another calibration curve.

This work shows that it is possible to measure the average resistance during very short intervals, by inserting the rapidly fluctuating resistance in one arm of the Wheatstone bridge. The conditions may be varied to suit the requirements. For example, the galvanometer may be in the circuit the same length of time the current flows through the bridge. Or, if the galvanometer is wanted in the circuit a shorter period than the time the current flows through the bridge, k_2 shown in Fig. 1, may be employed. Key k_2 may be adjusted to close the bridge circuit, k_2 to connect in the galvanometer and k_1 to open the entire circuit. A fourth key is required if the galvanometer circuit is to be closed after the bridge circuit is closed and opened before the bridge circuit is opened. The arc through which the pendulum swings is graduated throughout with respect to time. In this way it is possible to have the galvanometer in the circuit during any part of the time the current flows through the bridge. If it is desired to close the bridge circuit a longer time than the period of the pendulum will allow, it may be closed by hand and timed with a stop-watch, or the circuit may be connected by a mechanical device to a chronograph. This method of measuring resistances has been found of great value in determining the change of resistance of a selenium cell, and will doubtless lend itself to numerous laboratory applications. In measuring resistance by this method the self induction of the galvanometer does not introduce any material error.

John Zeleny exhibited "A Lecture Electroscope for Radioactivity," by means of which ionization effects could be projected upon a screen and made visible to a large audience.

Franz A. Aust presented a paper on "A Variable High Resistance of India Ink on Paper."

INDIA INK RESISTANCE.

High resistances varying from 0.02 to 30,000 megohms can very easily be prepared by ruling lines of India ink upon paper or by soaking the paper in the ink. While the permanency is not sufficient for a resistance standard it is nevertheless quite good. The temperature co-efficient is approximately 1.5 per cent. The carrying capacity is 0.2 milliamperes for heavy drawing paper and 25 milliamperes for asbestos paper.

At the meeting of the Chemical Section a number of interesting papers were presented, of which only two can be mentioned here.

F. C. Frary and J. B. Bolton, in a paper entitled "Direct Currents in a Closed Liquid Circuit," proposed to construct a unipolar dynamo with a glass tube filled with electrolyte as a conductor, to find out whether the migration of ions would take place without electrodes. The design of the dynamo was given.

In a paper entitled "Snow as a Means of Studying the Smoke Nuisance," G. B. Frankforter reported investigations showing the amount of carbon deposited from the air.

THE SMOKE NUISANCE.

Dr. Frankforter's investigation covered five weeks in December, 1909, and January, 1910. Samples of snow were taken from different parts of the city and chemical examinations made, which showed that over one gram of carbon fell on each square foot of the city's surface during the five weeks. This carbon is combustible and represents an economic waste since in the aggregate the unburned fuel represents some thousands of tons. In addition to this the smoke is obnoxious from the sanitary standpoint and has its part in destroying clothing and other property. If combustion could be made perfect the smoke nuisance would

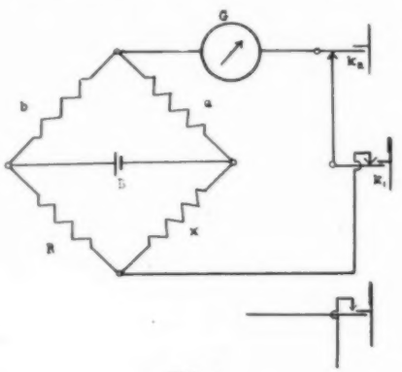


FIG. 1.

be abated and this is the great problem which is to be solved.

Charles F. Brush stated that the smoke nuisance in Cleveland produced a damage amounting to $12 per capita per annum. This damage results from the effect of the smoke on household goods, clothing, etc., and its interference with merchants in keeping their goods presentable. Legislation is being pushed in that city for punishing those responsible for the emission of smoke.

The Christmas meeting of the Association in 1911 will be held in Washington, D. C. Invitations from Honolulu and Portland to hold summer meetings were referred to the Committee on Policy. Charles E. Bessey, of Nebraska, was elected president of the Association; R. A. Millikan, vice-president for Section B, and Charles E. Howe, vice-president for Section D. W. F. Magie was elected president of the American Physical Society, and B. O. Peirce vice-president. The total registration at Association headquarters was 670, but the attendance was probably nearer 1,000, as many members of the affiliated societies were not included in the above registration.

National Electric Light Association May Get Strong Canadian Ally.

The *Canadian Electrical News* makes the interesting announcement that the committee appointed at the last convention of the Canadian Electrical Association to consider the proposal to affiliate with the National Electric Light Association has since submitted a report to the managing committee recommending affiliation. This report was approved by a majority of the managing committee at a meeting held in Toronto on November 12, when it was decided to call a special general meeting of the Association to consider the question and forthwith amend the constitution should the report be adopted.

A special meeting for that purpose will therefore be held in the committee room of the Prince George Hotel, King and York Streets, Toronto, on Friday, January 20. Two sessions will be held, at 10 o'clock in the morning and at 2:30 in the afternoon. This will be an interesting meeting and it is expected that there will be a large attendance and very general and thorough discussion.

The committee on affiliation points out that the National Electric Light Association has undertaken the work of organizing the electric light and power industry all over the continent for greater strength and influence, has already a large membership in Canada, and if affiliation is not adopted, will inaugurate a very active campaign for new members in Canada, and that it is better to work with it than compete with it. By affiliation the Canadian Electrical Association would become a geographic section of the National Electric Light Association.

The managing committee has decided to hold the next annual convention of the Canadian Electrical Association in Winnipeg, Manitoba. The date and other arrangements will be considered at the special meeting of January 20.

The Chicago Electrical Show.

There is every reason to believe that the sixth annual exhibition of the Chicago Electrical Trades' Exposition Company, which will be held in the Coliseum, Chicago, January 7 to 21, will surpass all former electrical shows, not only as to the number of exhibitors but also in the beauty and novelty of the decorative scheme, which has always been a big factor in making these annual expositions attractive to the public.

An entirely new scheme of decoration has been created by D. H. Burnham & Company, the well-known architects. Their former ideas along these lines have always surpassed anything of the kind ever disclosed in a trade show, and it is safe to predict that the decorative scheme for 1911 will eclipse anything before attempted. The general scheme of decoration will be entirely new. Looking upward the spectator will see the drapery of a great pavilion drawn aside to reveal in the center the cloud-flecked noonday sky. For producing this effect indirect lighting will be relied upon.

The fact that the management of the show is this year sharing a large percentage of the profits with the exhibitors pro rata is a source of much satisfaction to the trade, which has responded more quickly and more liberally in the matter of contracting for space.

The most distinguished exhibitor this year will be the United States government. This display will occupy the entire Annex and will include everything electrical pertaining to the War, Navy, Interior, Treasury and Post-Office Departments. In the Navy Department the electrical equipment of a modern battleship will be shown, together with wireless demonstrations and methods of electrical cooking recently adopted by the government.

Another interesting feature of the show will be the wireless exhibit of the Chicago Amateur Wireless Club and of the students of the Lane and Lake High Schools. This will be a working exhibit of apparatus made by the students and interesting demonstrations of the operation of this apparatus.

As in former years the three central-station companies of Chicago, the North Shore Electric, the Cosmopolitan Electric and the Commonwealth Edison Company, will make elaborate exhibits showing the various uses of electricity.

At the north end of the Coliseum, balancing the big government exhibit at the south, the Commonwealth Edison Company will have a unique and attractive model street called Commonwealth Avenue. This street will be brilliantly illuminated with the type of ornamental street lamp-post for incandescent lamps employed for the new lighting along Lincoln Avenue, near Belmont Avenue, Chicago.

The north side of this street is occupied by six stores, in each of which there is a distinctive method of illumination demonstrated. The sidewalk in front of them is slightly raised above the level of the Coliseum floor, giving

Poster by Garner.
THE ELECTRICAL SHOW POSTER.

a realistic effect, and the show windows of all the stores are beautifully trimmed and illuminated.

Beginning at the west end, the first is a model grocery and meat market. In the show windows are displayed an entrancing assortment of fruit and vegetables. The interior is finished in white enamel, and a McCay electric refrigerator with refrigerated show cases in connection is demonstrated. There are choice cuts of meat displayed to advantage in the refrigerated show case, demonstrating that this is the only satisfactory and sanitary method.

The equipment includes an electric chopper and coffee grinder, and incidentally a large electric coffee urn which will supply refreshment to visitors.

The next store contains household appliances using electric energy for various purposes, such as vacuum cleaners, washing machines and wringers, ice cream freezers, knife cleaning and sharpening machines, silver polishers, dish washing machines, and a "Federal" electric kitchen table equipped with a motor and countershafting, operating a great variety of devices for paring, coring, grinding, beating and mixing, etc., all in the most convenient and compact arrangement. A display of electric cooking utensils completes this installation.

Next to this comes the lamp shop, a vision of light and color containing a beautiful arrangement of ornamental electric lamps for every conceivable purpose, from the heavy standard six feet high, to the little piano lamp and the dainty little lamp for a lady's writing desk. There are also a number of exquisite pendent domes illustrating the latest ideas in art lamp glass ware.

Adjoining this is another most attractive store, beautifully stocked with the finest growing and cut flowers, flowering plants and shrubs, ferns and palms.

A handsome refrigerator for cut flowers, connected with the electric refrigerating plant in the grocery store mentioned above, is an important feature of this installation. It is illuminated by electric lamps located inside the refrigerator itself.

Of special interest to the ladies is the linen and lace display in the next compartment. It has been arranged to show some exquisite things here, and care has been taken to bring out their delicate beauties in the best possible way, which is of course with modern electric illumination. The arrangement is a model up-to-date display in dry goods and will include all the indispensable effects, such as concealed trough lighting to illuminate the show cases, etc.

Another in this famous row of model stores is devoted to men's furnishings. Here the most fashionable and attractive in this line is displayed, and in arrangement, illuminative features, etc., compares favorably with the previously described exhibit. At the same time, the lighting scheme is differentiated.

In fact one of the principal objects of this exhibit is to illustrate and contrast good methods of electric illumination of stores and show windows. It is quite certain that no better opportunity will ever be found to study this

important subject, and it is anticipated that before the show closes thousands of merchants who are alive to their opportunity in this direction will have made a careful study of this exhibit.

The comfort of visitors is assured as far as possible in the comparatively limited space, although this exhibit occupies the entire north end of the Coliseum. Oscillating electric fans and ozone generators will be installed to keep the air fresh and in circulation.

Another feature which is at once ornamental and of unique advertising value is the "Windolite" electric sign provided for each store.

The accompanying diagram and key will serve to locate the numerous exhibitors. There will be the usual special days, the schedule up to date being arranged as follows:

Monday, January 9—Souvenir Day—Puzzles.

Tuesday, January 10—Souvenir Day—Belt buckles and match boxes.

Wednesday, January 11—Chicago Electric Club Day.

Thursday, January 12—Illuminating Engineers' Day.

Friday, January 13—Women's Club Day.

Saturday, January 14 — Students' Day.

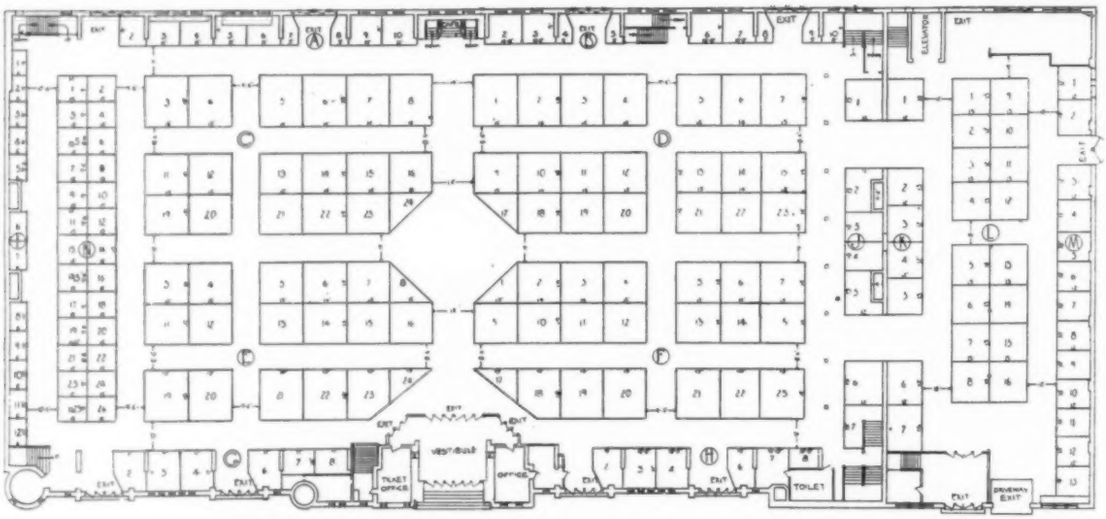
Monday, January 16—Souvenir Day—Telephones.

Tuesday, January 17 — Benjamin Franklin Day—Souvenirs.

Friday, January 20—Sons of Jove Day.

Saturday, January 21—Children's Day.

It is possible that the following special days will also be arranged: Electrical Vehicle Manufacturers; Electrical Contractors; Wisconsin; and Telephone.



PLAN OF COLISEUM FLOOR, CHICAGO ELECTRICAL SHOW, JANUARY 7-21, 1911.

Allis-Chalmers Co.—F, 17-18.
American Ironing Machine Co.—E, 19.
American School of Correspondence.—D, 14.
American Steel & Wire Co.—D, 17-18.
American Telegraph Typewriter Co.—D, 7.
American Telephone & Telegraph Co.—D, 19.
Anderson Carriage Co.—F, 20.
Apex Appliance Co.—A, 9.
Armstrong, G. W., & Co.—A, 6.
Automatic Electric Co.—D, 5-6.

Babcock Electric Carriage Co.—F, 23.
Birtman Electric Co.—A, 10.

Chicago Fuse Wire & Manufacturing Co.—D, 2.
Chicago Pneumatic Tool Co.—E, 4.
Chicago Telephone Co.—D, 10-11-12-20.
Commonwealth Edison Co.—Sections L and N.
Cosmopolitan Electric Co.—F, 12.
Crane Company.—D, 1.
Cutler-Hammer Manufacturing Co.—J, 6-7; H, 8.

Duntley Manufacturing Co.—C, 23-24.
Driver-Harris Wire Co.—D, 2.
Domestic Equipment Co.—D, 15.
Deane, J. R., & Co.—D, 3.

Edison Storage Battery Co.—F, 20.
Electrical Review Publishing Co.—E, 12.
Electrical Testing Laboratories—F, 14.
Electrical World—F, 11
Electrocraft Publishing Co.—B, 10.
Everson, C. G., & Co.—A, 3.
Electric Storage Battery Co.—F, 5.
Empire Vacuum Cleaner—J, 2.

Federal Electric Co.—J, 3-4.
Farrington Auto Co.—C, 16.
Flexlume Sign Co.—B, 5½.
Fort Wayne Electrical Works—C, 13.

Gage Publishing Co.—E, 20.
General Electric Co.—F, 1-2, 9-10.

Hughes Electric Heating Co.—F, 5.
Hurley Machine Co.—E, 5-6.
Hamler Eddy Smoke Recorder Co.—C, 4.

Hoskins Manufacturing Co.—E, 7-8.
Houston Manufacturing Co.—J, 1.

Ideal Electric Co.—F, 6.
Illinois Appliance Co.—A, 8.
International Text Book Co.—D, 14.

Janette Manufacturing Co.—B, 8.
Judd Laundry Machinery Co.—G, 6.

Keller Manufacturing Co.—F, 3-4.
Kimble Electric Co.—D, 13.
Kinetic Engineering Co.—D, 21.
Kratz, A. W.—A, 5.

Machado & Roller—B, 3.
Manhattan Electrical Supply Co.—E, 20.
Mailometer Co.—J, 5.
Macbeth-Evans Glass Co.—C, 21-22.
Miller Electric Co.—A, 7.
McCrum-Howell Co.—E, 13-14.

National Carbon Co.—C, 19.
National Electric Lamp Assn.—E, 21 to 24.
Newgard, Henry, & Co.—F, 13.
North Shore Electric Co.—E, 11.
Nuway Service & Sales Co.—B, 7.

Pelouze Electric Heater Co.—D, 9.
Perfection Vacuum Cleaner Co.—E, 3.
Philadelphia Storage Battery Co.—F, 22.
Popular Electricity Publishing Co.—C, 3.

Ralph Temple Auto Co.—F, 21.
Rider Ericsson Engine Co.—G, 7.
Rosenfield Manufacturing Co.—D, 4.

Sefton Manufacturing Co.—F, 7.
Swedish American Telephone Co.—C, 5.
Stolz Electrophone Co.—D, 7.
Studebaker Bros. Manufacturing Co.—E, 15,16.
Simplex Electric Heater Co.—C, 11-12-23.
Stamping Washing Machine Co.—B, 4.

Tel Electric Piano Co.—H, 3-4.
The Van Manufacturing Co.—B, 9.
Toledo Electric Welder Co.—D, 3.

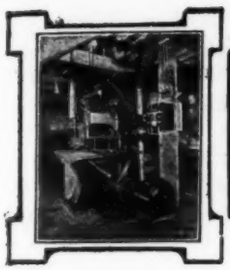
Vulcan Electric Co.—B, 5.

Westinghouse Electric & Manufacturing Co.—C, 7-8.

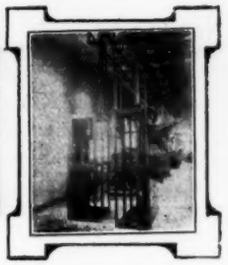
A New Wireless Invention.

A young Italian scientist, Professor Felice Jacoviello, has invented and recently tested with great success an appliance that seems destined to revolutionize wireless telegraphy and the transmission of electrical force. The chief advantages of this new appliance are that it utilizes a much higher percentage of the transformed electric energy than before, and permits the use of electrostatic condensers only one-twentieth of the size of those ordinarily employed.

The first experiments with the new arc were made on November 17 at the arsenal of Spezia. The wireless telegraph station at Venice on the other coast of Italy, to which the Hertzian waves were directed by the Jacoviello instrument, replied immediately that the signals had been received with extraordinary force and clearness.



Industrial Power



Motors for Gate Valves for Panama Canal Lock Service.

On account of peculiar requirements for heavy, intermittent duty in a comparatively unexplored field and under most inauspicious climatic conditions, much has been left to the ingenuity of designers in the drafting of specifications for the 236 motors which the Government intends to purchase for operating gate valves in the locks of the Panama Canal, and bids will be advertised for abroad as well as in the United States. While the normal amount of work expected of these machines is as shown in the duty cycle, the service will be intermittent, and the interval of operation may vary by weeks or even months from that now prescribed; and whenever, after a long period of idleness, the apparatus is called upon to operate, it must perform its duty without fail. On this account the best practice known to motor design must be called into play.

Engineers of the Isthmian Canal Commission believe that the types of motors which have already been developed and have successfully stood a year's test in the operation of steel rolling mills will best meet the present requirements, after suitable alterations have been made to guard against the deterioration of ordinary insulation and the rapid corrosion of metal parts to which experience has shown that the Canal Zone climate is conductive. In order to ascertain that the machines selected will hold their own under working conditions, the Government will first buy only two of each class and try them out in actual service. Though required to perform similar duty, motors for actuating the Stoney and the cylindrical valves will differ in power and in revolutions per minute.

Stoney gate valves will be used for letting water in and out of the lock culverts or tunnels, and, briefly described, the machinery actuating such a valve consists of a rising valve stem passing through a stuffing box in a watertight bulkhead, fastened to the gate valve at the lower end and to a guided crosshead at the upper end. The crosshead is moved vertically through a distance of eighteen feet by means of two vertical revolving screws, which transmit the pull through two non-revolving nuts in the crosshead. The screws are provided with roller thrust bearings at their upper ends to take the downward thrust. Each screw is driven from the motor shaft by a gear and pinion reduction and two bevel gears. Two sub-bases carry the motor, limit switch, extended motor shaft bearings and the thrust bearings.

Seventy-eight-inch cylindrical valves will let water from the main culvert of the center wall of the locks into the lateral culverts, and *vice versa*, and the operating machinery consists essentially of a guided rising valve stem fastened at its lower end to the cylindrical valve, and having a non-revolving nut secured to its upper end. This nut, with the valve and stem, is moved vertically through a distance of three feet by means of a revolving screw, the end thrust being taken up by a roller bearing at the upper end of the screw. The screw is actuated by a bevel gear driven by a pinion on the motor shaft. A combination casing and bedplate carries the motor, limit switch, bearings and all moving parts. When the valve reaches its seat, shock to the machinery is prevented by allowing the thrust screw to rise through a thrust sleeve, thus giving the motor time to stop without shock.

The motors for driving this machinery will be of the induction, totally-inclosed, moisture-proof, squirrel-cage form, of mill type, high torque, and designed for twenty-five-cycle, 220-volt current. Otherwise the design of these machines is unhampered by specifications—except as to endurance and efficiency tests—and alternate proposals are invited on modified forms which will facilitate construction, enhance the durability of the machinery, or conform more nearly to shop practice where the motors are to be built.

Climatic conditions on the Isthmus require that the insulation suffer no permanent injury when subjected to a temperature ranging from fifteen degrees to 100 degrees centigrade, when the humidity is from eighty-seven to 100 per cent. When operated as shown in the duty cycle diagram the temperature of no part of the motors will be allowed to rise above that of the surrounding air by as much as forty degrees centigrade. If the room tem-

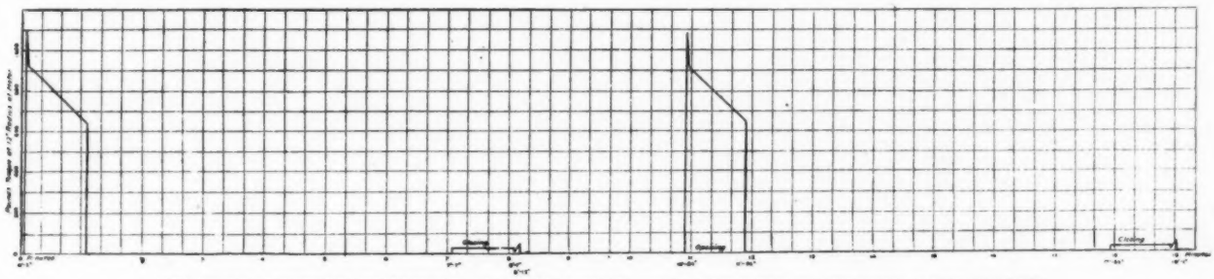


DIAGRAM SHOWING SEQUENCE OF OPERATIONS FOR ONE MOTOR—STONEY GATE VALVE.

perature varies from twenty-five degrees centigrade, a corresponding correction will be made, according to the standardization rules adopted by the American Institute of Electrical Engineers.

Characteristic curves for each machine to be worked out by the designers are: pounds torque at one foot radius in relation to synchronous speed from zero to 100 per cent; line current at 220 volts in relation to synchronous speed from zero to 100 per cent; relation between slip and horsepower from zero to 175 per cent; relation between current and horsepower from zero to 175 per cent; relation between power factor and horsepower from ten per cent to 175 per cent, and the relation between efficiency and horsepower from ten to 175 per cent. In order to permit the production of the heating effect due to the duty cycle shown in the diagram without subjecting the machines to full torque during tests, the designers will be required to prepare tables showing the equivalent torque at one foot radius which will produce the specified rise in temperature when operating and resting alternately for periods of one hour each during twenty-four hours per day. Motors for driving the Stoney gate valve machinery will have a starting torque of 1,200 pounds at one foot radius and full-load speed of 480 revolutions per minute. Those for actuating the cylindrical valve machinery will have a starting torque of 150 pounds at one foot radius and full-load speed of 625 revolutions per minute.

The Commission's requirements provide that in general construction the motors shall be as simple as possible consistent with thorough reliability, and sufficiently rugged for completely successful operation.

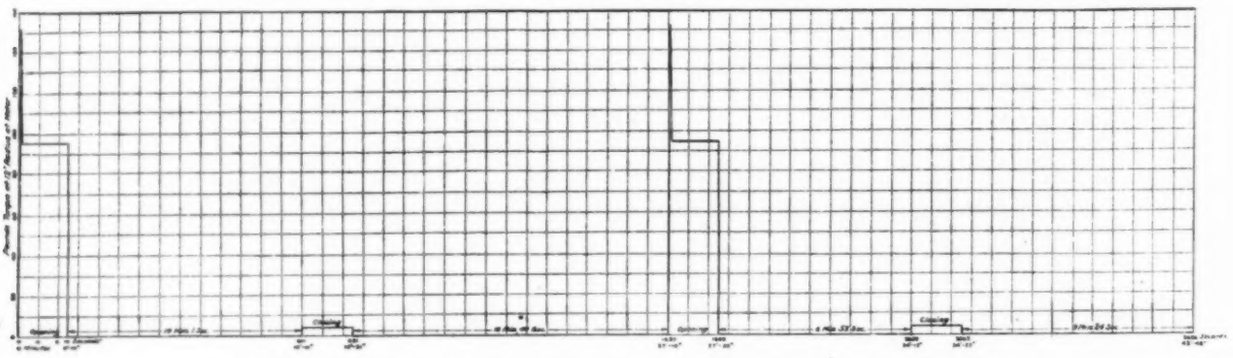


DIAGRAM SHOWING SEQUENCE OF OPERATION FOR ONE MOTOR—CYLINDRICAL VALVE.

New Form of Waterpower Permit.

The Agricultural Department of the United States has a new form of waterpower permit, and new regulations for waterpower plants in the National Forests, which provide for the issuance of a preliminary permit, which secures to the party making the first application protection during the time necessary to make his final surveys and procure the data for the issuance of the final permit. The new permits will terminate at the expiration of fifty years, unless sooner revoked by the Secretary of Agriculture, and the charge will be based upon the net horsepower capacity of the plant, beginning with a charge of ten cents per horsepower during the first year, and rising gradually ten cents per year to $1.00 per horsepower in the tenth year, which charge will continue thereafter.

Computed for the fifty-year period, the charge under the new permit is about thirty per cent less than under the old form. Provision is made for a readjustment every ten years of the factors upon which the estimated capacity of the plant is computed. It is believed that the new regulations will encourage extensive waterpower development in the National Forests under provisions which will fully protect the interests of the people.

Coal Production in 1910.

According to reports received by the United States Geological Survey from coal-mine operators and others familiar with the industry, the production of coal in the United States during 1910 was between 475,000,000 and 485,000,000 short tons, a considerable increase from the output of 459,715,704 short tons in 1909 and approximately within one per cent of the maxium previous record of 480,363,424 tons, in 1907.

Carelessness in Mine Wiring.

An instance of cable installation in a coal mine, which was described in *The Engineering and Mining Journal* shows something of the lack of care often taken with such work. In the case of the mine mentioned, a lead-covered cable carrying the 500-volt lines was dragged through the conduits with no protection whatever. The result was that several corners and projections tore in the cable no less than two dozen gashes, of which some were twelve inches in length. It was only when the power was put on the line and the damp insulation began to burn that the trouble was discovered.

Electric Locomotives for Panama.

The Panama Canal Commission is planning to build a rack railroad on which electric locomotives will be operated to move shipping through the Panama Canal locks. The Canal Commission will start the work by advertising for 8,000 tons of track material and necessary apparatus.

Electric Signal Lantern.

A patent has been applied for on an electric lantern to replace the oil lanterns now in use on railroads. The invention comprises a storage battery connected to an incandescent lamp placed in the standard oil lantern and provided with a push-button switch. This arrangement allows for the switching on and off of the current and, according to the inventor, should replace the old swinging sysetm of signaling.

It is stated that a company, recently formed in Indiana, is planning to erect a number of electric power plants in the coal fields of Indiana for supplying current to the various mines.

TELEPHONY—TELEGRAPHY, and WIRELESS.

IMPORTANT DEVELOPMENTS IN LONG-DISTANCE TELEPHONY.

ENORMOUS MILEAGE OF LOADED CIRCUITS SUCCESSFULLY PHANTOMED. WORK ON THE NEW YORK-DENVER CIRCUIT. COMBINED TELEPHONE AND TELEGRAPH WORKING.

The year 1910 has proved to be a notable one for the achievements in telephone engineering which have been accomplished by the American Telephone & Telegraph Company. Although 150,000 miles of overhead wire in the plant of that company had been successfully loaded, the working of such loaded wires, as parts of phantom circuits, had not been made practicable for use on a commercial scale.

During August, 1910, a commercial trial of a phantom loaded circuit was undertaken on open wires between Philadelphia and Pittsburg. The results of this trial demonstrated the correctness of the theories involved, and proved that a way had been found for loading phantom aerial circuits. Prior to this demonstration it was necessary where phantom circuits were to be employed to work them without the benefit of loading, and where loaded circuits were employed they could not be phantomed. The success of this Pittsburg-Philadelphia experiment demonstrated that loaded circuits could be phantomed and that the phantomed circuit thus obtained could be loaded; that they could be rendered practically free from extraneous noises and that the phantomed circuit could be made more efficient than either of the side circuits of which it is composed. As a result of the experimentation pertaining to this subject, an enormous mileage of loaded circuit can be utilized in the formation of phantomed circuits, thus greatly increasing the wire facilities without any substantial increase in cost. Owing to the increased efficiency obtained on the phantom circuits a great increase in the possible range of speech transmission is secured.

Another forward movement during the year of very great importance in the advancement of long-distance telephony is the solution of the problem of loading the overhead circuits of heavier gauge, principally those of No. 8 B. W. G. These circuits being of high efficiency, a greater refinement in loading methods is called for, on account of coil losses and insulation losses, which would be without substantial adverse effect in the loading of wires of smaller gauge, such as those of No. 12 B. & S. An extended series of experiments was concluded during the year, which demonstrated that by the use of porcelain insulators of special construction the required degree of insulation at the points of support could be obtained, and that by the use of special transposition systems and by refinements in insulating methods throughout the line the No. 8 wires could be successfully loaded.

The problem of working on the phantom principle circuits of No. 8 gauge, even when not loaded, has hitherto presented formidable difficulties, owing to the losses introduced by the transforming coils and growing out of the necessity of having coils which would serve equally well for ringing and signaling purposes. By ingenious improvements in this terminal apparatus the problem of operating unloaded No. 8's on the phantom principle has been solved, so that at the close of 1910 it is possible to phantom overhead circuits of all sizes, whether loaded or unloaded, thus adding enormously to the flexibility and interchangeability of the circuits composing the long-distance system and making possible the standardizing of methods whereby the transmission to all long-distance points will be greatly improved.

While the fundamental engineering work upon which all of this is based must be credited to the year 1910, the beneficial results to be expected from it will not be felt until the season of 1911 is well advanced. Their importance, however, will be more and more manifest as years go on.

A part of this work, which narrowly misses the right to be chronicled during the year 1910, is the circuit from New York to Denver. The work upon this circuit has progressed so far that the theory upon which it is based is found to be sound and that the computations are correct. This circuit may justly be called the most remarkable circuit yet attempted. It is designed to consist of two pairs of No. 8 B. W. G. wires from New York to Chicago, one pair of No. 8's from Chicago to Omaha, then two pairs of No. 8's from Omaha to Denver. The talk from New York to Denver will be accomplished over the phantom circuit composed of all these wires, which are to be loaded and phantomed. While the talk from Denver to New York is taking place, two other conversations may go on between Denver and Omaha and two more conversations between Chicago and New York, all without interference with each other.

In addition to this, the circuit may be used for telegraphic purposes, the four wires composing the telephone circuit between New York and Chicago being used for telegraphic purposes between those two cities, each wire being duplexed. While this is going on the four wires between Omaha and Denver may be used telegraphically in the same manner, each being duplexed. At the same time that all this is being done, the two wires between Omaha and Chicago may be worked telegraphically, each wire being duplexed. If desirable, this circuit can be cut into still smaller sections telegraphically, giving eight messages passing between New York and Buffalo, eight messages between Buffalo and Chicago, four messages between Chicago and Omaha and eight messages between Omaha and Denver.

The successful development of a duplex or phantom cable capable of being used for telephone transmission be-

tween New York and Washington is another result of the telephone engineering activities of 1910. A conduit to provide for this cable is now nearing completion. The cable itself is of a type which has been successfully tested during the year between Boston and Neponset, Mass., and consists of fourteen phantomed pairs of No. 10 B. & S., forming a central core, around which are grouped thirty-six phantomed pairs of 13's (B. & S). In the interstices of the cable between the 10's and 13's are some unphantomed pairs of smaller gauge. The phantomed pairs in this cable will be loaded in a manner analogous to that employed for the phantom aerial circuits. This New York-Washington cable is intended to form part of an underground system, which ultimately extends from Washington to Boston. On the New York-Boston route the subway and cable already extend from New York to New Haven at one end and from Boston to Providence at the other, leaving a gap of about 125 miles to be filled.

Among switchboard systems the most interesting and important development has been the work of the Western Electric Company in the so-called semi-mechanical exchange. A practical trial of this type of apparatus has just begun at New York with a system embodying all of the elements which would be found in an exchange of 100,000 lines. This switchboard was installed for the purpose of obtaining exact scientific information, which could only be obtained from a practical trial. This installation, while in successful operation, has not been working sufficiently long to furnish the important data which are to be obtained from it.

The alliance between the American Telephone & Telegraph Company and the Western Union Telegraph Company has resulted during the year in a very large use of the telephone company's plant by the Western Union Telegraph Company and a large use of the telegraph plant by the telephone company. The same high degree of scientific engineering work which has characterized the development of the telephone in America is now being applied to the telegraph. During the year a large number of engineering studies pertaining to telegraph systems and their relation to telephone circuits have been undertaken. It is too early to obtain a report of the achievements in these matters; they must remain for the record of 1911, which promises even more fruitful results both in telephone and telegraph engineering than any which have been thus far accomplished.

Automatic Telephone Service in Chicago to Be Opened Soon.

The Illinois Tunnel Company, of Chicago, announces that it has secured over 37,000 individual approved service contracts for its new automatic telephone system. Its ordinance requires 20,000 telephones to be in service by June 1, this year. It is expected that this number will be in operation before April 1. As many of the lines have already been completed and instruments installed, it is intended to begin the first regular service about January 10 and to extend it as rapidly as possible.

Four exchanges in the central business district are practically completed; these are located as follows: Main office in Chronicle Building, Washington Street near Fifth Avenue; Chemical Building, Dearborn and Washington Streets; Brooks Building, Jackson Boulevard and Franklin Street; building at 19 Plymouth Court. Four other exchanges are being built in the outlying district, two on the South Side, one on the West Side and one on the North Side.

The four central exchanges have an initial capacity of 24,500 lines and the four outside exchanges of 5,000 lines each. The final capacity of the exchanges will be about double these numbers. The entire system is being laid out with a contemplated ultimate capacity of 1,000,000 lines, to be secured by additions to the present exchanges and the erection of others.

Construction work on the new system was begun on May 6, 1910, cables being installed in the company's tunnels under practically every street of the downtown district. At the close of the year twenty-seven miles of conduit with 118 duct miles were laid outside the downtown district and where the tunnels have not yet been built. The construction work is being done by the Subway Telephone Construction Company and the telephone equipment is furnished by the Automatic Electric Company, both of Chicago.

United States Army Makes Practical Use of Wireless.

Seemingly reliable newspaper dispatches state that the United States War Department is to use wireless telegraphy to communicate between various army stations in the West. Orders were received at the headquarters Department of the Missouri in Omaha on December 30 to cease sending army telegrams by commercial telegraph lines and to make use of the wireless system which has been installed at Fort Omaha and in Fort Leavanworth and Fort Riley, Kas.

Stations also are being installed in the army posts in Cheyenne, Denver and other western points. There is a large volume of telegraphic communication between the Omaha headquarters and the army posts, particularly those in Kansas. For that reason Fort Leavenworth and Fort Riley were equipped immediately after the station at Fort Omaha.

Possibilities for Telephone Development in China.

An American consular agent in China reports that he has reliable information that the Board of Communications, which controls the telephone system, is in favor of its general extension. One of its members recently expressed himself enthusiastically in favor of telephone extension in China, and said that he believed that every city of sufficient magnitude within the empire would possess telephone facilities within a very few years. It need hardly be suggested that American manufacturers who are not already in touch with the Board of Communications should send representatives to Peking. The market for telephones in northern China seems particularly favorable.

Northwestern Ohio Telephone Conference.

Managers of the Northwestern Ohio telephone companies, constituting the Ohio Independent Telephone Association, met at the Secor Hotel in Toledo, O., during the week of December 26.

The most important subject which came under discussion at this meeting was the proposed public utilities bill, which will be presented before the Legislature and which, if carried, will place all telephone properties under the control of the state.

QUESTIONS and ANSWERS

SEPARATELY EXCITED SERIES BOOSTER.—In doing some testing work it was necessary to raise the voltage of our direct-current lines from 110 to 115 volts, which we did with a small direct-current generator connected in series with the apparatus we were testing. The booster was belted to a line shaft and separately excited with a weak field current regulated by means of rheostats. The belt slipped at times, and I was told that if the belt should break or come off the booster would act as a motor and run away in a very few seconds, and that for that reason I must at all times be ready to open the line switches. Will you please explain just why the motor would run away and what the effect of a belt breakage would be if the generator was being used to buck down the voltage instead of boosting it.—B. L. T., Des Moines, Iowa.

When the generator is belted to a shaft and connected electrically for operation as a booster, the armature probably carries what is about full-load current for the machine. The field in this case is, however, exceedingly weak and, although the machine has only a slight torque, its direction of rotation, if running free as a motor, would be the same as when it is being driven by the belt. Should the belt break or come off, the machine, which was formerly a booster, would become a motor without load with an extremely weak field, and as it was already running at about normal speed, it would accelerate to an enormous velocity in very few seconds, so that the coils would probably be thrown out of their slots and the commutator ruined. If the machine were bucking down the voltage, its field would necessarily have been reversed, therefore it would be necessary for it to stop, reverse and start again, after which it would run away as in the first instance.

ALARM FOR FENCE PROTECTION.—On a ranch in the Southwest it was desired to use three barbed fence wires, which may be connected electrically. Upon these wires it was desired to place telephone service and also to connect some cells so arranged that, should the wires be cut, a warning bell would be sounded at the guard gate. Could this be done? If so, how?—J. L. H., Chicago.

This is quite feasible by the principle of the closed-circuit burglar alarm. Two of the wires, say the upper and middle ones, may serve for the telephone circuit. One of these and the third wire may serve for the alarm circuit without interfering with telephone conversation. The two wires of the alarm circuit are connected together at the remote end of the fence and a closed-circuit battery and relay complete the circuit at the guard gate. Here there is also installed a local open alarm circuit which is arranged so that if the relay armature drops, due to a cut or break in the fence wire opening the external circuit, it will close the local circuit and ring the alarm bell. If the fence is very long, it may be sectionalized and a separate relay and bell provided for each section; in this case the same closed-circuit battery may be used for all the sections, likewise the same open-circuit battery may be connected to all the local circuits. Placing the bell direct in the fence circuit and depending on that being closed by the grounding of the loose ends of the broken or cut wire would not be reliable because of the improbability of getting a good ground connection in each case.

ARC LAMPS FOR INDIRECT LIGHTING.—Can arc lamps be used effectively for indirect lighting? How should they be placed? What are the results?—J. H., Washington, D. C.

Arc lamps have been used quite effectively for indirect lighting in stores, waiting rooms, offices, drafting rooms and other large interiors where there is a white or brightly tinted ceiling. The lamps should be of the inverted direct-current type, that is, with positive carbon and regulating mechanism below so as to throw the bulk of the light upwards and have as little obstruction at the top of the lamp as possible. Conical reflectors of high reflecting power should be placed around the lower part of the lamp so as to direct all downward rays against the ceiling and to cut off all direct rays from the eye. The results are very satisfactory with efficient and well regulated lamps if the reflectors are kept clean. It has become more customary to use tungsten lamps for indirect lighting. As to the relative efficiency of various lamps for indirect lighting see the article on "Indirect Illumination with High-Candlepower Tungsten Lamps" in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of September 10, 1910.

SERIES CUT-OUT FOR TUNGSTEN LAMPS.—In street lighting with series tungsten lamps, how is the circuit maintained when a lamp burns out?—J. H., Peoria, Ill.

Series incandescent lamps, whether of carbon or tungsten filaments are generally provided with an automatic cut-out to short-circuit the lamp terminals when the lamp fails from a broken or burned-out filament. The cut-out is a device arranged in the socket and consists of two contacts connected with the lamp terminals and separated by a thin piece of paper or, in the more recent lamps, by a thin strip of shellaced veiling. From this originates the name film cut-out. While the lamp is burning the voltage across the terminals and therefore between the two contacts is relatively low, seldom over fifty volts. If the lamp fails while the circuit is live, the full voltage of the circuit is impressed on the two contacts and, as this exceeds the rupturing strength of the film, the latter is readily punctured.

SPECTRUM ANALYSIS.—I would like to know whether all the minerals can be detected by spectrum analysis.—C. O. S., Los Angeles, Cal.

The minerals as such cannot be detected by spectrum analysis, but their metallic constituents can, as each metal has a distinctive line or group of lines in the spectrum.

MAGNETITE ARC LAMPS.—How many magnetite arc lamps are used in this country?—M. R., Toledo, Ohio.

It has been estimated that there are 100,000 magnetite arcs now in use.

Edison Electric Illuminating Company of Brooklyn.

The year 1910 has been the most prosperous in the history of the Kings County Electric Light & Power Company and the Edison Electric Illuminating Company of Brooklyn. The former is the owning and financing company in control of the entire lighting industry of the borough, and the Edison Company is the operating company, which deals with the consumers. The broad-gauge policies of the company in its dealings with the public, the efficiency of internal operation, and the alert and progressive methods used in securing and retaining business have produced a development within the year just past, which exceeds all previous records. The increase in gross earnings during 1910 amount to approximately $600,000.

The ratio of expenses to earnings has been improved, and the net result correspondingly increased. After charging more than $525,000 to depreciation, the net divisible surplus for the year will be at least 9.75 per cent and possibly 10 per cent on the total capital stock of $10,000,000.

During the year the Kings County Company issued $2,500,000 of 6 per cent convertible debenture bonds, the full interest on which has been included in the year's expenses.

Expenditures for capital purposes are increasing in amount year by year, keeping pace with the growth of the borough, and aiding particularly in the development of outlying sections.

Dividends have been continued on the Kings County stock at the rate of 8 per cent per annum. This rate has been paid continuously since its adoption, the disbursement of December 1 last being the forty-third consecutive dividend.

Possibly the most noted development during the year was the institution of the profit-sharing and pension plan, which was announced during the past month. In this feature of welfare work the Brooklyn Edison Company has taken the lead, and is the first of the large corporations in the city to establish such co-operative measures as between stockholder and employee.

A system of pensions for aged or incapacitated employees who have been with the company ten years or longer has also been established.

The lighting and power business connected to the company's mains, and which is computed in "50-watt equivalents," during 1910 reached a total in excess of 2,000,000. It took from 1889, when the company began business, to 1907 to amass a business which amounted to the equivalent of one million units. The connected load added in the past three years is, therefore, equal to that connected during the previous eighteen years. The additional connections during 1910 amount to the equivalent of about three hundred thousand lamps. The amount of current generated and consumed was greatly in excess of any previous year. The amount of current sold during the month of December just past exceeds that of any previous month in the history of the company.

The number of city arc lamps has been increased in Brooklyn during the year to over 5,000. The Manhattan bridge has been illuminated. Fort Greene Park and Prospect Park have both been equipped for the first time with an adequate system of electric illumination. The posts used are artistic and were designed by the Municipal Art Commission. In Prospect Park 450 of these posts have already been installed, and 300 more will follow, this illumination replacing 150 gasoline lamps. Each of the new posts carries an 85-watt tungsten lamp. They are placed on all the drives and the walks, 100 feet apart.

The city has also contracted with the Edison Company for 400 horse-power to operate the flushing system for cleansing Gowanus Canal, which will be in operation early in 1911.

An interesting development that has taken place during the year is the inauguration in Brooklyn of merchants' decorative street lighting. The first installation of this has taken place within the last two months on Bedford Avenue between Putnam Avenue and Madison Street, the equipment consisting of a number of artistic posts, each surmounted by five 100-watt tungsten lamps, surrounded by opal globes. The local merchants themselves contract and pay for this street illumination with the idea of increasing the attractiveness of their respective localities. The company has a number of contracts already under way for this type of lighting in different parts of the city, and the indications are that it will spread during the coming year.

A number of large customers have discontinued the use of their private plants for Edison service, and renewal contracts have been signed for the supply of all lighting and power to Luna Park, Dreamland, Brighton Beach, and the Manhattan Beach Estates, Coney Island.

Dry Dock No. 4, at the Brooklyn Navy Yard, has been built entirely with power supplied by the Brooklyn Edison Company. This required a maximum of about 1,000 horsepower. All the contractors for the Fourth Avenue subway have also contracted with the Edison Company for a supply of electrical energy and are using this in the construction of this public improvement.

A comprehensive plan to secure the electric equipment of unwired Brooklyn residences has been inaugurated during the year, and is meeting with gratifying results. This plan, widely advertised by the company, consists of an offer to install an electric equipment for any house owner in the borough and receive payment therefor in monthly installments with the lighting bills as they become due.

Two other notable features contributing to the total of 1910 achievement are the largely augmented sale and use of household cooking and heating appliances, and the increasing popularity of the electric vehicle, some of the largest concerns in the borough having adopted or extended the use of these vehicles during the year.

Motor Trucks In An Elaborate Setting.

Because the National Commercial Motor Vehicle Show in Chicago is to be held the week following the Tenth Annual Autumobile Exhibition and in the same buildings, the display of power vehicles for all sorts of business purposes will have the same elaborate and beautiful setting.

The main features of the decoration of the Coliseum building will be four fountains extending down the center aisle of the main floor, illuminated vases mounted ten feet in the air on ornamental bases extending away to right and left of the fountains, clusters of incandescent globes atop of ornamental posts rising between the vases, and an ornate ceiling simulating stained glass.

Tungsten lights are to be used on a large scale. Protruding through the stained glass ceiling at intervals of eleven feet each way will be 500-watt tungsten units.

New Electrical and Mechanical Apparatus and Appliances.

New Freight Locomotive for Street Railway Company.

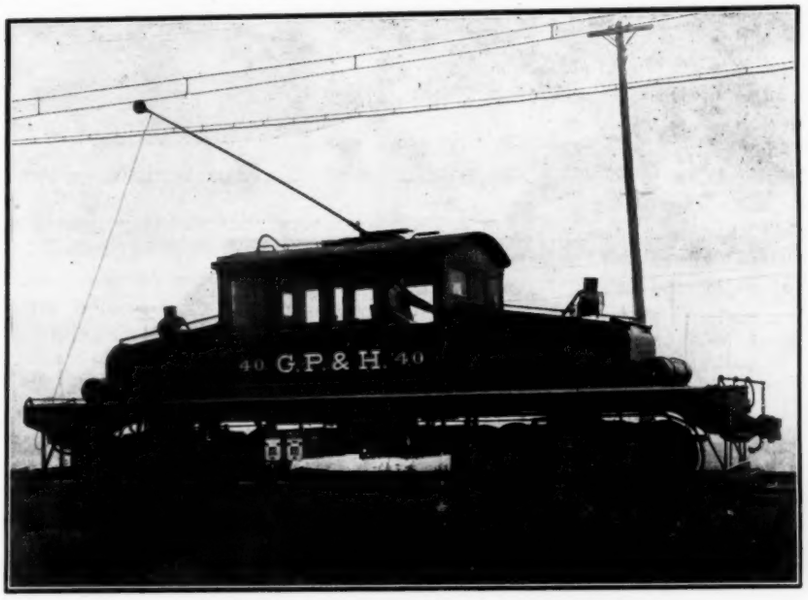
The accompanying illustration shows a view of the new electric locomotive recently purchased by the Galt, Preston & Hespeler Street Railway Company, Ltd., of Ontario. This company operates some thirty cars on a standard-gage interurban line, twenty-one miles in length, connecting the above points with the towns of Freeport, Centreville, Berlin and Waterloo. The power station and repair shops are located at Preston. The railway traverses a farming country and does a thriving business in both local and through passenger and freight service.

Several years ago the company purchased from the Westinghouse Electric & Manufacturing Company a quadruple equipment consisting of four No. 93-A direct-current motors with a nominal rating of sixty horsepower each at 600 volts, for a locomotive similar to the one shown, but of smaller capacity. Its operation has been eminently satisfactory in every respect and the recent order for a larger locomotive of the same general characteristics argues strongly for the excellence of design and low maintenance charges of this type of slow-speed freight locomotive.

Much has been said about the impracticability of electric freight haulage, but the steadily increasing sales of slow-speed electric locomotives, especially designed for freight service, and the invariably favorable reports of operation, is affirmative evidence of the most forceful nature. There are many interurban electric roads tapping sparsely settled farming districts and outlying towns not favorably located on main steam trunk lines, which could develop a highly profitable express and freight traffic with the aid of a suitable electric locomotive.

The locomotive shown in the accompanying cut was built by the Baldwin Locomotive Works and the complete electrical equipment furnished by the Westinghouse Electric & Manufacturing Company of Pittsburg, Pa. It is designed for the standard-gage track and provided with double-swivel trucks. The wheel base is twenty-nine feet and the overall dimension thirty-six feet and it weighs complete 100,000 pounds. The gear ratio of 16.57 gives a normal speed of 8.25 miles per hour, at which speed a tractive effort of 18,220 pounds is developed. The maximum tractive effort is 25,000 pounds. The locomotive carries a quadruple equipment consisting of four interpole, direct-current railway motors having a nominal rating of 100 horsepower each, or a total of 400 horsepower at 600 volts. These motors are fitted with special windings adapting them particularly for slow-speed locomotive service. Standard nose suspension is used.

The well-known Westinghouse unit-switch control was provided; as experience has shown this system has many commendable features as regards simplicity and uniform positive operation. Two master controllers are supplied, one in each end of the cab. These controllers carry only the very small current from a storage battery, for exciting the electromagnetically actuated needle valve which admits air at seventy pounds pressure to the air cylinders of the unit switch. The action of each switch is therefore positive and independent of fluctuations of the line voltage. It not infrequently happens on interurban and stub-end lines that the voltage at points far distant from trolley feeders is as low as 200 volts when the motors are in operation. Under such extreme or even less severe conditions solenoid-operated contactors, depending upon the line voltage for their contact pressure, are very apt to give trouble due to looseness and arcing at the contacts. With air-operated switches all such possibilities are eliminated and the greatest reliability under all conditions assured.



NEW FREIGHT LOCOMOTIVE FOR ELECTRIC RAILWAY.

Pennsylvania Railroad Installs Train Dispatching Telephones in Philadelphia Terminal.

The Pennsylvania Railroad is installing a telephone system of controlling train movements at its Philadelphia terminal. This is believed to be the first installation of a complete telephone dispatching system within the limits of a terminal.

This system is unique, being in some measure a telephone train wire having intercommunicating features only between certain points. Dispatchers' offices are located at "S" tower, which is a telegraph office at Thirty-second Street, and at "A" tower, at Seventeenth Street. At the latter point three calling equipmnets are provided, which enables any one of the three operators to call any station, while at "S" but one calling equipment is provided.

The various way stations, of which

there are fifteen, can call automatically either "S" or "A," but there is no provision for calling the other way stations. Accordingly both dispatchers' offices are equipped with selectors, as are the regular way stations.

Under ordinary operating conditions the dispatchers at "A" will call the various way stations, but in cases of emergency the "A" tower will be cut out and the train movements controlled from "S." The complete equipment of telephone and selector apparatus was supplied by the Western Electric Company.

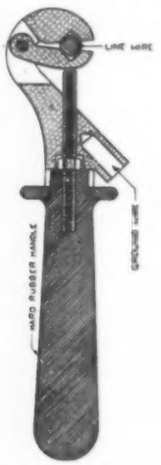
Dossert Connectors for Grounding High-Tension Lines.

The accompanying illustration is a sectional view of a new handy and convenient device for attaching ground wires to high-tension lines or for use in connecting temporary leads to a line, which is being placed on the market by the firm of Dossert & Company, New York, N. Y.

The construction of this connector is plainly shown in the accompanying illustration. In operation, when the hard-rubber handle is turned to the left the steel stud is released from the lower contact jaw and this jaw swings down, thus permitting the connector to be placed over the line wire.

When the handle is turned in the other direction the stud forces the two jaws together and a contact is obtained on the main line. The ground wire is held in the connector by means of jointed set screws or solder.

The employment of this device, it will be readily seen, will effect a marked saving in labor and cost.



NEW DOSSERT CONNECTOR FOR GROUND WIRES.

New Shop-Lighting Fixtures.

The question of the proper lighting of shops and factories is a much discussed one, owing to the remarkable difference in output of a well-lighted workroom and a poorly lighted one. The advent of the tungsten-filament lamp has done much towards bettering lighting conditions generally, but particularly in shops have the results been noticeable.

SINGLE-LIGHT UNIT.

Tungsten clusters have become very popular for this class of lighting as they meet practically every condition imposed on them. In the accompanying illustrations are shown two types of shop-lighting fixtures which have been installed in a number of shops with satisfactory results.

SHOP CLUSTER EQUIPPED WITH SHOCK ABSORBER.

The cluster type shown is of all-steel construction, with shade and receptacle plate made in one piece. The shade is eighteen inches wide and is designed along the most scientific lines to produce the best distribution of light. It is finished with a reflecting coat of white porcelain enamel. This cluster may be equipped with four sixty-watt or four 100-watt multiple, or four 100-watt street series lamps in vertical position. The stem of the fixture is twelve inches long and is one-half inch iron pipe. It is either furnished with ceiling crowfoot or the shock absorber, shown in one of the illustrations.

The unit shown in another illustration is designed especially for a 250-watt multiple lamp. The shade of this fixture is eighteen inches in diameter and is coated with white porcelain enamel. The stem is of one-half-inch iron pipe fifteen inches long.

The shock absorber shown herewith is intended for use with any fixture having a one-half or three-eighths inch conduit and is provided with suitable terminals for connections. The conical spring and the intervening lamp cord prevents injurious shocks from reaching the lamps.

The shock absorbers and fixtures are being manufactured and placed on the market by the American Arc Lamp Company, Kalamazoo, Mich.

AMERICAN SHOCK ABSORBER FOR SHOP FIXTURES.

Contract Awarded.

The Northwestern Engineering & Construction Company, Milwaukee, Wis., has received a contract for the building of the Sterling-Moline Traction Company's interurban line in Illinois. The contract price is given as $2,800,000.

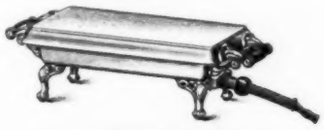
Pelouze Toaster-Stove and Griddle.

The Pelouze toaster-stove and griddle shown herewith embodies a utilization of new principles in the art of electrical heating, and may be said to represent a distinctively different system of applying electrical heat. This new method might well be called the "radiant suspension" of applying heat.

The heating element in the Pelouze toaster is complete in one piece with the contacts. It is supported from underneath by one screw. All heating elements are interchangeable and can be replaced by any one should an accident ever occur. The current consumption of this toaster is 450 watts.

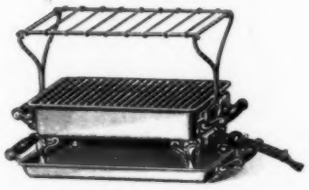
In the new Pelouze toaster provision has been made for adequately taking care of crumbs. An attractive nickel-plated tray is provided for catching the crumbs, which is easily removed from one end. This decided advantage and improvement overcomes any objection that can be made to a horizontal toaster.

The stove attachment, or chafing dish, taken in connection with the toaster, produces a most practical and useful cooking device, which combines successfully an efficient toaster-stove and griddle. The Pelouze toaster includes also an upper rack, intended for keeping the toast hot after it is made, or as a plate warmer. This rack is easily removed when the toaster is used as a chafing griddle.



TOASTER USED AS GRIDDLE.

TOASTER USED AS STOVE.



PELOUZE TOASTER.

Attention is especially called to the improved quick-break switch block. Attached to the switch block is a tempered spiral spring having a knob near the center for the purpose of detaching the switch block from any device. The effect of the tempered spring causes the switch block to be detached with a quick break, thus doing away with all possibility of arcing. The Pelouze Electric Heater Company, Chicago, Ill., are the manufacturers.

New Electric Pump.

An electrically-driven air compressor which is particularly suitable for use in saloons, hotels, etc., for pumping beer, is shown in the accompanying illustration.

VARWIG BEER PUMP.

This apparatus comprises a motor-driven compressor encased in a glass globe mounted on an attractive pedestal. The air is drawn into the globe through a glass jar containing water, which filters the air before it is compressed. An electric incandescent lamp also mounted in the globe is lighted whenever the motor is in operation. This feature adds to the attractiveness of the device.

The Varwig Manufacturing Company, 120 Opera Place, Cincinnati, O., is the manufacturer of this pump.

Electric Riveting Machines.

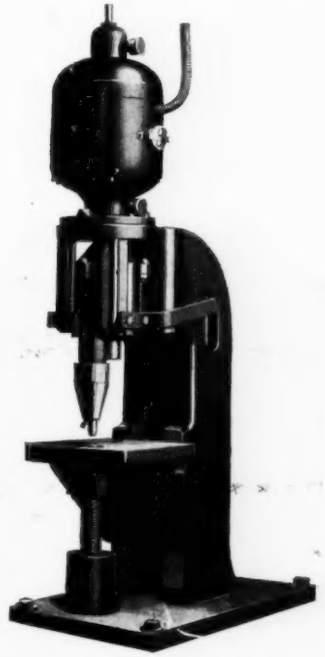
The accompanying illustration shows a new type of electrically-driven riveting machine, which, owing to its many commendable features, is meeting with marked success.

The mechanism of these riveters, which are known as the "Ajax," is very durable and simple, consisting of a slidable solid steel revolving disk block having on its lower surface three special designed striking shoes, these shoes in turn striking a resiliant plunger, which strikes a powerful blow directly on the work to be done.

Herewith is shown the bench-type machine, which is adapted for driving and heading at one operation. When using this machine the rivet is forced through tin, sheet iron, or steel and riveted. The riveting operation is controlled by the foot and by releasing the foot pressure the blow is stopped instantly.

Attention is also called to the semi-portable yoke for riveting double edges and reinforcements around tanks, feed-troughs, range ovens, etc. This machine can be operated hung horizontally, vertically or upside down. It can also be bolted to any stationary upright post or wall. The semi-portable type is usually suspended by a steel tiller rope or pulley wheel fastened to the ceiling or joist, being evenly counterbalanced so that light pressure will raise or lower, suitable to the work being done.

These riveting machines, which are being placed on the market by the Mechanical Appliance Company, Milwaukee, Wis., are furnished in a number of various sizes and types.



AJAX RIVETER.

Some tests have lately been made with aluminum commutators, with a view to substituting this metal for copper. The chief trouble which presented itself was the difficulty of connecting the copper conductors to aluminum bars.

Three-Phase Transformers.

Until quite recently it has been almost universal practice to employ combinations of single-phase units for polyphase transformation, while in Europe the composite type of three-phase transformers is in very common use, and very popular. The main argument used against the three-phase transformer here is the danger of interrupted service, due to a possible disablement.

With present methods of transformer manufacture, the well known, or easily determined quality of all materials used, modern protective devices, against static, surges or accidental "shorts," about the only cause for transformer breakdown is over-loading.

For two-phase work, which, however, is not very common, no material advantage can be gained by combining two transformers in one, but for three-phase work, a system most generally employed, the combining of three transformers in one, effects a very material saving in several respects, and may be summed up as follows: First, improved efficiency and regulation, as applied to installations requiring from five to one hundred kilowatts transformer capacity, for larger installations this feature will not be so marked. Second, reduced weight, resulting in lower first cost, less transportation expense and much easily handling. One single transformer of a given capacity will weigh nearly one-third less than three smaller transformers aggregating the same capacity, and first cost is reduced in nearly the same proportion. Economy in space occupied, simplicity of connections and improved appearance generally, are points in favor of the three-phase transformer that need only passing mention in this article. Third, ideal electrical results; no phase regulation on your system is needed. Phases will remain balanced under widely varying conditions of load, when used for lighting, or mixed lighting and power load where it becomes practically impossible to keep the load balanced, the three primary phases will be drawn on practically alike under these conditions.

THREE-PHASE TRANSFORMER—SUBSTATION TYPE.

KUHLMAN THREE-PHASE TRANSFORMER.

The Kuhlman Electric Company, Elkhart, Ind., built its first three-phase transformer in July, 1903, and claim to be the first, or at least among the first, to offer this type in this country. Since that time it has been perfected, and today after a number of changes in design, they claim to have a transformer that is theoretically correct in design and thoroughly reliable in service.

The transformer has three magnetic circuits in its core, of exactly equal reluctance, a very desirable arrangement which is found only in this design. These circuits are joined as are the wires of a three-phase circuit. On each of these cores is wound a primary and secondary coil, or coils as the case might be. The primary coils are then connected in star, the secondary in delta. This connection is employed because by means of it the phase regulation more nearly approaches perefection than with any other connection.

These transformers are built in sizes of from five kilowatts and larger, and for any frequency and voltage. As they are primarily a power transformer, which are intended to operate under constant load, the standard design calls for core and copper losses to be nearly equal, this resulting in highest efficiency at full load, and slightly greater overload capacity. Where special conditions are to be met, however, such changes in this regard as may seem best can always be made.

Regarding mechanical features, the transformer is encased in a sheet-steel tank supported in a substantial cast base, with cast rim and lid. The smooth case is used in sizes of from five to twenty kilowatts, while with the larger sizes the corrugated case construction is employed. The five to fifty-kilowatt sizes in voltages up to 6,600 are furnished for pole suspension.

New Indirect-Lighting Units.

One of the notable innovations in electric lighting which has grown up with illuminating engineering is what is now termed the indirect method. This illuminating system is particularly suited to certain classes of lighting and

FIG. 1—NEW INDIRECT-LIGHTING UNIT.

in many notable installations the results have been noteworthy.

With the advancement of this system of lighting there has been a parallel development in the design of indirect-lighting units and at present there are available innumerable designs and patterns for every conceivable class of installation.

In the accompanying illustrations are shown two of the newer designs of fixtures which are being placed on the market by the National X-Ray Reflector Company, Chicago, Ill.

Fig. 1 is a rather severe design which will harmonize with a variety of architectural treatments. It is intended for use with the large tungsten lamps—250 and 400 watts.

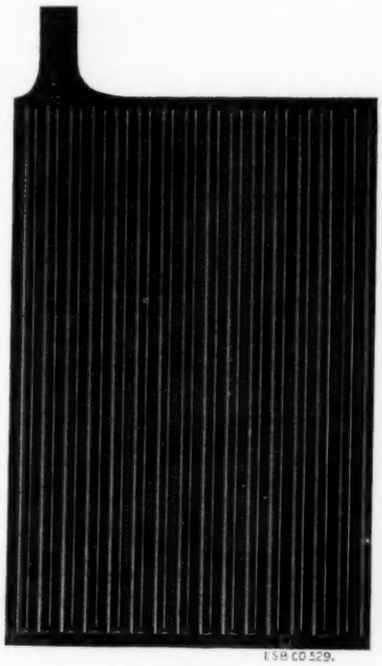
Fig. 2 is an ornate and distinctly classical design. The material is a composition which may be given any desired finish. The indirect-lighting fixture of this type offers a solution of the problem of electrically lighting to interiors of strictly classical design. At the same time the fixture affords the necessary visible source of light supply, suggesting a bowl or vase overflowing with light.

FIG. 2—NEW DESIGN UNIT.

The Westinghouse Electric & Manufacturing Company has offered to make a trial installation of its metallic flame arcs for street lighting in Cincinnati, O., in view of the impending renewal of the street-lighting contract.

New Storage Battery.

In line with its policy of progressiveness, the Electric Storage Battery Company, Philadelphia, Pa., has recently developed a new electric-vehicle battery, which will be placed on the market in 1911. This new battery will be called the "Ironclad-Exide." It is said to be the latest and highest development of the "Exide" battery.



NEW EXIDE POSITIVE PLATE.

The "Ironclad-Exide" battery is the result of years of study and experimentation and long tests already made have proven its dependability.

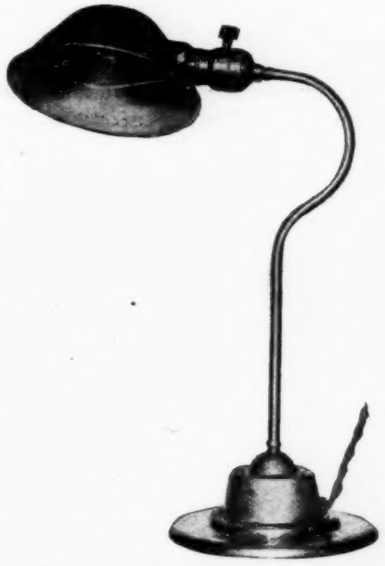
The "Ironclad-Exide" battery is the perfection of a battery first invented by a Frenchman. The Electric Storage Battery Company secured the American rights on this patent about four years ago, and since that time has been carrying on experiments in an endeavor to perfect this battery. This has now been accomplished and under severe tests has shown the most satisfactory results.

The new "Ironclad-Exide" positive plate shown in the accompanying illustration is so designed as to effectually prevent the loss of active material. The plate consists of a metal conducting top and bottom bar connected by vertical conducting rods. Each rod is surrounded by active material, which in turn is protected and held in place by a slotted hard-rubber tube. This tube carries a vertical rib on each side which takes the place of wood separators, used with the standard "Exide" type of positive plate and makes the use of rubber separators unnecessary. A thin flat wood separator spaces the "Ironclad-Exide" positive from its negative. The negative plate is a modified "Exide" negative plate thickened and improved, to enable it to withstand, not so much the increased capacity, as the truly unprecedented life of the new positive plate.

According to the manufacturers the "Ironclad-Exide" battery has the following points of superior merit: It gives from two and one-half to three times longer life; active material does not shed from the plates, which eliminates the necessity for ever cleaning the cells; it gives increased mileage and maintains this high capacity during the greater part of its life; the "Ironclad-Exide" battery can be installed in standard "Exide" battery jars so that vehicle users having "Exide" batteries can substitute the new battery when requiring renewals.

Adjustable Electric Light Fixtures.

Probably no phase of human ills has received so little attention at the hands of modern science as that resulting from misuse of the eyes. It is only during the past few years that science, having given the means of producing better light, has shown how it should be used to preserve and protect the eyes.



FRANKS ADJUSTABLE DESK OR READING LAMP.

In this connection the adjustable fixture, capable of being placed in such

a position as to provide light where it is most needed, has been an essential factor and is considered as among the most efficient tools the illuminating engineer now has at his disposal.

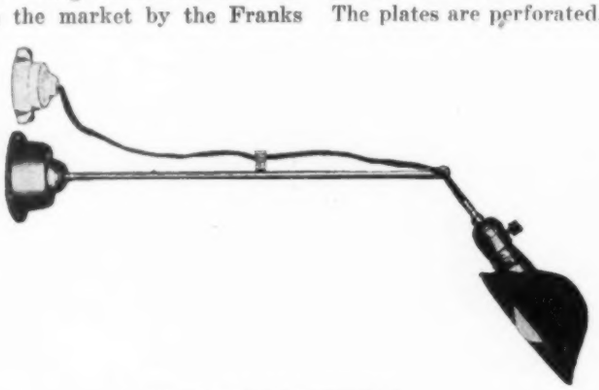
An innovation in this type of fixture, having a patented adjustable feature, has recently been perfected and is shown in the accompanying illustrations. As may be seen, the patented feature has been embodied in fixtures adaptable for use in the home, the office and the factory, and the latter type has been installed in many large factories.

It has been proven time and time again that to provide for the health and comfort of workers is a profitable investment for the employer. The fixture shown in Fig. 1, installed in factories, will help immeasurably to attain this result, as the fixture may be attached to the ceiling or wall, near the outlet, and the lamp adjusted to any position.

Also with the desk, piano, bathroom, bedroom and kitchen types, the light can be directed in any direction and the fixture easily moved out of the way when not in use.

The adjustable feature comprises a ball seated between the base of the fixture and a plate, each having openings large enough to allow the ball to move freely and give sufficient radius. The ball is clamped between the base and plate by bolts and spring means, the resulting tension permitting the ball to be adjusted to any desired position.

The fixtures described and illustrated above are being manufactured and placed on the market by the Franks Manufacturing Company, Rock Island, Ill.



FRANK'S FACTORY FIXTURE.

The Consolidated Car-Heating Company, New York, has received the contract for installing heaters in the fifty surface cars recently ordered by the Boston Elevated Railway.

New Portable Storage Battery.

In the accompanying illustrations are shown the new Hirsch portable storage battery which the Pennsylvania Storage Battery Company, Philadelphia, Pa., is placing on the market and which it is claimed is a distinct departure in storage-battery manufacture.

HIRSCH PORTABLE STORAGE BATTERY—HALF SIZE.

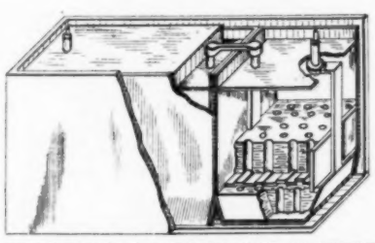
In this battery there are but two plates per cell, placed horizontally in each, which are comparatively thick, thereby having increased storing capacity. The batteries are said to be so constructed as to stand the constant jar and jolt of an automobile and do not easily get out of order.

The manufacturers state that the success of this new battery is due to the position and construction of the plates. The plates are perforated, thereby giving large active surface, and are well made, strong grids. The electrolyte has free access to every part of the plate, and since the active material is in such close contact with the plate itself, the internal resistance is said to be extremely low.

The formation of peroxide of lead in the positive, and reduced as spongy lead in the negative plates, is by a special process rendered sufficiently porous to utilize it with the least loss of reaction in the electrolyte, occasioned by the charge and discharge.

The plates are placed horizontally in each cell, the positive plate is at the bottom and consequently the sediment cannot short circuit the plates.

One of the accompanying illustrations shows a view of the Hirsch battery complete, this view being about one-half actual size. The other illustration is a view showing the construction of the battery.



CONSTRUCTION OF HIRSCH BATTERY.

Variable-Speed Polyphase Motors.

In the accompanying illustration is shown the Kimble variable-speed polyphase motor, controller and rheostat. The Kimble Electric Company employs for speed variation the well known rheostatic control, and with the exception of two or three points, the conventional ideas are followed throughout.

In a phase-wound motor, the current from the main line is fed to the stator, and a current is induced in the rotor. If the rotor current is passed through rheostats, the motor will operate at reduced speeds. By cutting out the rheostats, step by step, the speed can be brought up through any desired range.

The Kimble motors always operate on any rheostat point, with equal resistance in each phase of the rotor, resulting in quiet operation, with the minimum heat in the rotor windings.

The general rule is to operate the phases unsymmetrically for the sake of cheapness of construction in the controller. The stator used in the variable-speed motors is the same as is used for the constant-speed induction motor, the only difference being in the rotor, which is a wound rotor, and is equipped with slip rings.

The controllers are of the "drum" type and of very substantial construction. The core is composed of eight

pieces of solid cast bronze, carefully machined and fitted and firmly mounted on a center shaft, to which is attached the controller handle. A common practice in small controllers is to attach thin strips of metal to a fiber or wooden core. The Kimble method confines any arcing there may be to the contact fingers, which can be replaced at slight cost. This arcing, however, in the Kimble controller, is very slight, the life of the contact fingers is therefore long, and they seldom have to be replaced.

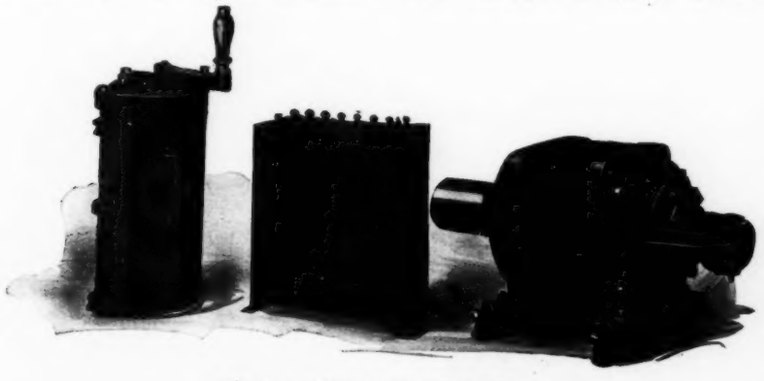
The amount of resistance used in the rheostat, at each controller point, determines the speed of the motor at that point for a constant load.

If the load is always the same, the rheostat can be calculated accurately to give the desired speed range. If, however, the load is variable, the speed no longer depends wholly upon the controller setting, but is affected also by variations in the load itself. In other words, a certain amount of load on the motor is necessary, to make the control effective.

For this reason, the proper rheostat to be used depends very much upon the nature of the work done by the motor. To meet the various requirements, the Kimble Electric Company is prepared to adjust the rheostat to suit each individual case.

The rheostat itself is housed in a well-ventilated stiff iron cage. The resistance is composed of special resistance wire of ample size to carry the current without danger of overheating.

There are no soldered joints, the rheostat being composed throughout of one wire, and the absence of cast grids renders the rheostat free from damage, due to accidental breakage of the grids by jar or temperature changes. This rheostat may be designed to perform any service.



KIMBLE MOTOR AND STARTER.

New Series Sockets.

The series socket illustrated herewith has been especially designed for use with tungsten-filament lamps, although any type of lamp can be used.

The "push-in" feature of the series socket used in the past has been entirely eliminated, thereby avoiding the possibility of breakage of the filament when putting the lamp in. This has been accomplished by arranging the socket to screw into the receptable instead of pushing in.

NEW SERIES SOCKET.

The socket carries a cut-out which operates in case the lamp burns out or is broken, and the receptable is arranged with a short-circuiting device which automatically closes the line when the socket is removed. This socket is so designed that it can be used with all types of fixtures now in use.

This socket is made by the Philadelphia Electrical & Manufacturing Company, 1228-36 North 31st Street, Philadelphia, Pa.

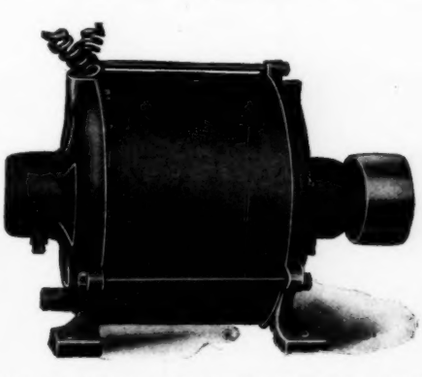
It has been decided to extend the telegraph lines of Brazil to the confluence of the Agra River with the Paraguay River, thus facilitating communication in the interior of the country.

Single-Phase Alternating Current Motors.

The introduction of the numerous motor-driven household and office appliances, which are operated by persons inexperienced in electrical apparatus and usually run from a lamp socket, has called for reliable motors and starting devices.

In the accompanying illustration is shown a single-phase alternating-current motor, being placed on the market by the Advance Electric Company, St. Louis, Mo., which is particularly adapted for this class of service. In the design of these motors the manufacturers state that no new or untested element has been incorporated, the aim being to combine to the greatest extent the best characteristics of the commutator-type and squirrel-cage type motors.

The field core of this motor consists of electrical sheet-steel punchings assembled rigidly in the frame shell, which is a plain cylinder. The armature core is built up of punchings having at the surface a circle of partially closed slots. In these slots a winding similar to a direct-current armature is placed and connected to a commutator in the same way. The brushes bearing on the commutator are all connected together, short-circuiting the winding. Under these partially closed slots is a circle of holes through which copper bars are placed. These bars are bent down over and soldered to the brass clamping flanges, forming a squirrel cage. This squirrel cage is set some distance below the commutated winding, allowing a part of the magnetic flux to pass through the commutated windings without penetrating the squirrel cage. By varying the strength of these windings and the amount of magnetic leakage between them the wide range of operating characteristics required for the various classes of service



SINGLE-PHASE ALTERNATING-CURRENT MOTOR.

The brush holders are of the simple box type, with provision for removing or replacing the brushes without moving or dismanteling any part of the machine. The studs carrying the brush holders are screwed solidly into the commutator end-plate so that when the brush holders are assembled they are solidly short-circuited, and are always directly opposite the openings in the end-plate and easily accessible.

Luceo Shades and Reflectors.

Luceo glass which is used in the shades and reflectors made by the Jefferson Glass Company, Follansbee, W. Va., is a special glass with unusual diffusing properties. It has very little absorption and this absorption is nearly uniform for all colors. This is plainly shown when a thin globe is used around a light source of high intrinsic brilliancy, for the filament appears white, whereas with many other kinds of glassware under like conditions the filament will appear very red, showing unequal absorption of the different colors. Luceo glass is made up in a variety of forms for shades and reflectors, two of which are shown in the accompanying illustrations. These shades are designed to give an artistic appearance as well as high efficiency from the standpoint of illumination. They present a handsome appearance whether the lights are burning or not.

The reflectors have been designed to give a proper distribution of light in the places where it is needed. Recent tests which were made at the Electrical Testing Laboratories in New York city show a distribution of light as indicated in the accompanying illustrations, the numerical values for which are given in the following table.

Reflector No. 4038 gives almost uniform candlepower through a range of sixty degrees upon either side of the vertical. Reflector No. 4008 distributes the light so that it is almost uniform over a horizontal plane throughout an angle of about ninety degrees under the lamp. In the case of all of these reflectors the light is very largely concentrated below the lamp, giving a high mean hemispherical candlepower.

LUCEO REFLECTOR NO. 4024.

DISTRIBUTION OF LIGHT IN VERTICAL PLANE.

Angle from Axis.	Candlepower						
	Lamp alone 60 Watt.	With Luceo Reflector No. 4010.	Lamp alone 100 Watt.	With Luceo Reflector No. 4026.	With Luceo Reflector No. 4038.	Lamp alone 40 Watt.	With Luceo Reflector No. 4008.
180°	....	23.8	....	41.1	44.4	....	11.1
165°	9.0	26.8	16.8	46.6	46.8	8.2	14.2
135°	39.0	29.1	44.5	48.2	40.8	24.5	17.7
105°	50.8	25.9	83.9	42.7	29.9	31.7	18.5
90°	50.2	24.0	84.6	36.6	34.0	32.5	17.1
75°	47.7	33.1	80.6	38.8	75.	31.5	16.8
60°	42.8	49.3	66.8	65.	96.	28.0	27.8
45°	32.2	60.0	50.2	92.	94.	23.4	40.8
30°	24.4	56.	39.5	97.	97.	16.7	37.6
15°	17.7	63.	28.7	110.	98.	7.5	33.0
0°	13.4	59.	21.3	109.	97.	3.2	27.7

Foregoing results obtained with frosted-tip lamps of 60 and 100 watts and clear bulb lamp of 40 watts.

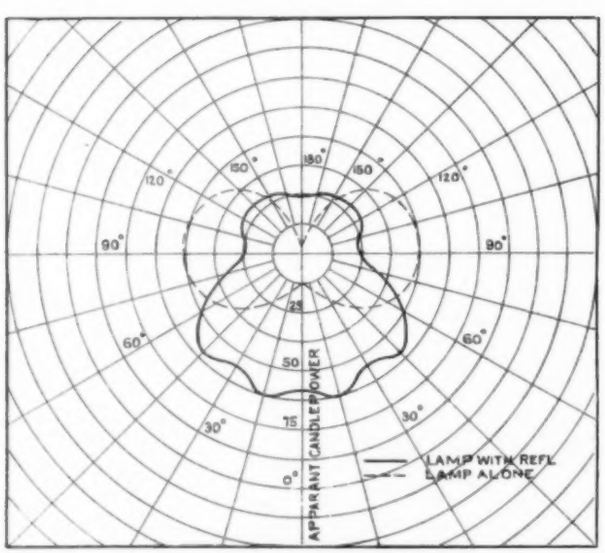
New Sectional Cutout Boxes.

The Columbia Metal Box Company, New York, N. Y., has just brought out a new sectional cutout box which has many commendable features.

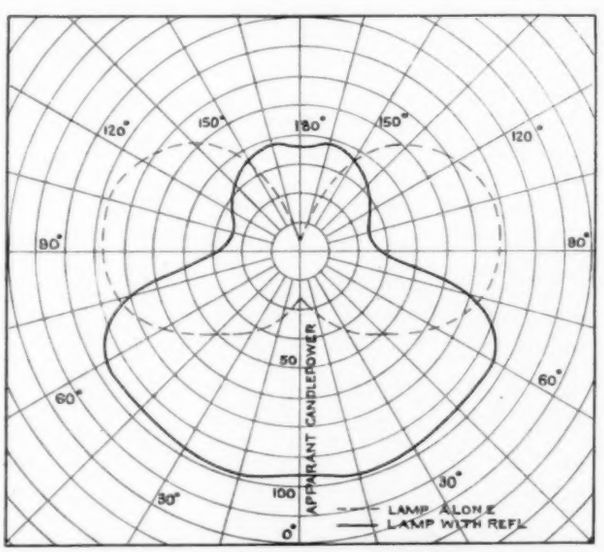
One of the many valuable features of this new box is the fact that universal cutout holders are supplied with every body section. These holders eliminate all drilling for cutouts and switches. This new box also contains knockouts for half-inch conduit evenly spaced on all sides.

It frequently happens that boxes already installed must be enlarged. Formerly it was necessary to tear out and throw away the old box, substituting a new one of the required size, but where such a condition arises it will only be necessary to remove a few screws and add one or more sections as the work may require.

The sectional principle has another advantage. It is often found necessary to use large conduits and the drilling of the holes has been very difficult to



DISTRIBUTION OF LIGHT ABOUT A SIXTY-WATT TUNGSTEN LAMP EQUIPPED WITH LUCEO REFLECTOR.



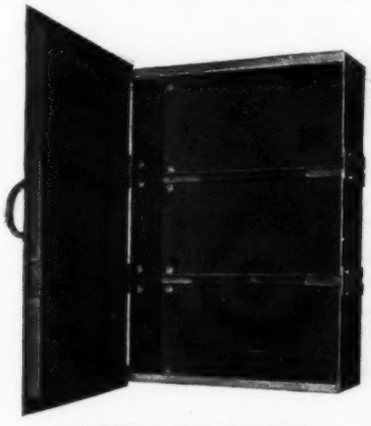
DISTRIBUTION OF LIGHT ABOUT A 100-WATT TUNGSTEN LAMP EQUIPPED WITH LUCEO REFLECTOR.

LUCEO REFLECTOR NO. 4026.

accomplish in boxes already made up, as few shops have drills suitable for the work. This necessitated having the boxes made to order which, of course, added to the cost and delayed the work. With this box it is only necessary to take a section to the nearest drill press and have the holes drilled to suit in a few minutes.

When assembled, which is accomplished by means of a few stove bolts, the boxes present a very substantial and neat appearance.

The unique but simple construction of this box is well illustrated by the cut shown. It will be readily seen that the cover extends over the edges of the body of the box one-quarter of an inch, allowing the box to be used on the cheaper grade of work requiring flush boxes, as well as for surface work. The fact that the covers can be applied at any time permits the installation of the bodies when the roughing is being done, which is often necessary in some classes of work. In some cases wooden doors and trims are required, on heavy dies from sheet steel and ab-



SECTIONAL CUT-OUT BOX.

and in such instances the covers need not be used at all.

The sections are stamped and drawn solute accuracy and uniformity are thereby assumed.

They are made in three widths, nine inches, twelve inches and sixteen inches. The sections consist of a body section, cover section, end section, and connecting strip section and cover connecting strip.

All parts are interchangeable and are packed in heavy cardboard cartons, and as a great many sections can be packed in a very small space, it enables a jobber or contractor to carry an unlimited assortment of sizes for a minimum investment of money and space.

New Benjamin Fixtures.

In line with the increased demand for large-unit incandescent fixtures, the Benjamin Electric Manufacturing Company, Chicago, Ill., is offering the trade the three new devices which are illus-

FIXTURE NO. 1621.

trated in the accompanying illustrations.

Fixtures No. 301 and 0201 have integrally-formed socket shells and shade holders and are equipped with either chain suspension or with a brass stem. The former has a 10-inch by 6-inch globe, and standard base socket for 100

FIXTURE NO. 0201.

to 250-watt lamps; the latter has either a sixteen-inch bowl-shaped or a twenty-inch flat-cone opal reflector, and large base socket for 400 to 500-watt lamps. The glassware is supported by five screws.

Fixture No. 1621 resembles an arc lamp in appearance, and is designed to be hung in its stead and in substantially the same manner. It has either an eighteen-inch bowl-shaped or twenty-inch flat-cone enameled-steel reflector of special design. Fixture No. 69 is equipped with a large base socket, and an enameled-steel hood. It is suitable for either in or out-door service, and is furnished with two forms of suspension, namely, with weather-proof porcelain connecting block only; or with connection block and cross arm.

Electric Plant for Scottish History Exhibition.

To supply the Scottish History Exhibition in Kelvingrove Park with electric energy for lighting and power the British Westinghouse Electric & Manufacturing Company, Ltd., offer to install the plant on condition that the Corporation agree to purchase the plant after the termination of the exhibition at the price of $24,000, which is considerably less than cost price, at such times as their requirements in the way of extensions may necessitate, the price not to be paid until the plant is installed in one of their generating stations or substations; and that, if only part of the plant is taken over to begin with, the payment shall be pro rata of the lump sum offer of $24,000.

The engineer in charge having stated that at least one-half of the plant will

FIXTURE NO. 301.

be required next winter, and that the acceptance of the offer will save the Corporation the expense and trouble of removing transforming plant from one of the generating stations to the exhibition and taking it back again towards the end of October, at a time when it might be too late to be of use for the next winter's load, the Electricity Committee recommend its acceptance.

A Wood-Burning Generating Station.

In the Orsk goldfields of Eastern Siberia electrically driven dredges are to be installed. An interesting feature of the steam plant which furnishes power is that wood is to be used exclusively as fuel.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, DECEMBER 23.—It seems after all that the Municipal Electrical Association will not introduce a bill into Parliament asking that all municipalities shall be given powers to wire premises for electric lighting, and to sell or let on hire electrical apparatus. Several factors have led to this. In the first place the general political situation is extremely uncertain, whilst the Electrical Contractors' Association, by dint of much work, has been able to enlist the sympathies of the large party of people of anti-municipal feelings, and at the same time it has been successful in accumulating a very substantial emergency fund. On the other hand, the path of those municipalities desiring these powers is not so smooth. Quite a number of authorities already have the right to do that which is asked for by the remainder. Hence it is that the support given on the municipal side is not absolutely unanimous, and indeed it cannot be.

We still seem to be a long way from finality in street lighting in London. I have more than once referred to the numerous types of street lamps that are to be found in the metropolis, and a continental expert aptly summed up the position when he remarked that London in the matter of street lighting, is "the laboratory of the world." In addition to the experiments that are being carried out in the city of London with arc lamps suspended by wires in the center of the roadways; by central arc-lamp standards; and by metal-filament lamps, and also the competitive experiment in Holborn between the Electric Supply Companies and the Gas Company, the Lewisham Council, not being an electric supply or gas authority, has adopted the plan of leaving gas and electric light companies to indulge in a competitive scheme, both companies being given the use of a certain portion of the same street. One of the features of Lewisham is what is known as "Electric Avenue," where a most effective scheme of shop and street electric lighting is being carried out as the result of co-operation between the shopkeepers and the Electric Supply Company. On this same question of electric v. gas street lighting, it is interesting to note that in Westminster, which has recently become the "hub" of the gas company's universe, owing to electric lighting having been displaced to a small extent, the shopkeepers in one of the most fashionable thoroughfares are complaining of the inefficiency of the new gas lighting.

The Smoke Abatement Exhibition which was recently held under the auspices of the Glasgow Electricity and Gas Departments, realized a profit of about six thousand dollars. A small portion is to be handed over to the departments for expenses incurred, whilst the remainder is to be given to the Air Purification Committee, which the Glasgow Corporation have appointed with the object of bringing to the notice of manufacturers and others, the advantage of scrapping isolated steam and other plants in favor of electric drive, the power being obtained from one central source.

An interesting description was given at the Institution of Electrical Engineers of the manufacture and laying of the new telephone cable between England and France, which cable is fitted with loading coils on the principle initiated by Pupin. The advantages of loaded cables on the Pupin method compared with continuous loading were discussed, and Sir John Gavey, a past engineer-in-chief of the General Post Office, gave particulars of a cable of the latter description for ordinary underground cables in Buenos-Aires. He specified an air-space, paper-insulated cable with 100-pound copper conductor, lapped with a soft iron tape, the two being annealed, then coated with a heated varnish and insulated. He was able to achieve an improvement in this cable of ninety-four per cent in the speaking tests. G.

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, DECEMBER 24.—A new section of Metropolitan subway has been lately opened for traffic in the central part of town. It runs from the Place de l' Opera to the North and East railroad depots. Eventually the line will be much longer and will run to the city limits. Construction work is now going on for a tunnel under the Seine in the outlying district, and caissons have already been sunk in the river for the purpose. At the Concorde bridge an extensive piece of work is being carried out for another subway line which will cross by an iron tube tunnel under the river. This latter work is being carried out by the Daydé & Pillé firm of Paris.

I note an electric lighting and gas project for the town of Gaillac, France. A hydraulic plant is to be erected on the Venelle stream for supplying the communes of Selongey and Foncegrive. At Touzac, the municipality is considering an electric lighting project. Plans for electric tramways are being drawn up for lines running between Ouques and Chateaudun, also from Blois to Amboise and Clery.

The Worddeicf wireless telegraph station of Germany is now undertaking to send time signals once a day to vessels at sea, in the same way as the Eiffel Tower is now doing. The Carpentier-Rochefort establishment of Paris is engaged upon a government contract for wireless outfits upon six battleships of the French fleet and twelve sets to be installed on torpedo destroyers.

At Aarhus, Denmark, a project is on foot for a central station which is to work upon a power network in the region lying north of this point. The plans also include an electric tramway line from Aarhus to Ronders. An extensive project in Norway relates to the building of a hydraulic plant combined with electric furnace works for producing iron and steel, and it is expected to turn out 700,000 tons annually. At Domnarfvet there are building electric furnaces which are to have 4,000 horsepower output. It is stated that ten of the furnaces will be set running next February. Operations are being carried on at Hoeganaes for erecting ten electric furnaces.

The Italian Government wireless corps has been experimenting of late with the new Jaciovello arc system and it is claimed that some remarkable results are obtained with it. Tests were made at the Monte Mario station at Rome and also at Milan and other posts.

Electric traction matters are active in the region of Budapest upon some sections of standard-gauge railroad. The first sections to be equipped will be the Budapest-Fiume and the Galanta-Zsolna portions of the state railroads. Current can be obtained for the Fiume line from hydraulic plants in that region. A DE C.

CANADA.

(Special Correspondence.)

OTTAWA, ONT., DECEMBER 31.—Private corporations, believed to be backed by Canadian railway magnates, Messrs. Mackenzie and Mann, of Toronto, are reported to be securing every available hydroelectric site on the Winnipeg River, below Lac du Bonnet and Point du Bois, where the city of Winnipeg is completing its $2,000,000 power plant. The city fears competition.

Permanent power is now being received at the city of Port Arthur, Ont., direct from Kakabeka Falls. The energy recently turned on relieves the power shortage that for some time has seriously affected the street railway and light systems of the city. It is less than a year ago that the taxpayers of Port Arthur ratified the agreement with the Hydro-Electric Commission of Ontario.

The complaint of the citizens of St. John, New Brunswick, lodged through the Board of Trade of the city, against the New Brunswick Telephone Company, promises to result in a long-drawn-out legal war. The complaint which was filed with the Public Utilities Commission of the province, alleges that the Company's rates are exorbitant and unjust, and asks the Commission to revise these rates and reduce them.

News has been received here from the far East that arrangements are being made by the Marconi Wireless company to link a chain of stations around the world and to this end a powerful station is being constructed at Suva, Fiji Islands. An official of the wireless company has been sent to Suva to begin work. The Fiji Islands station will communicate with Sydney, Australia, and it is stated that arrangements will be ultimately made for a high-power station at Victoria, B. C. The main chain will be from Great Britain to Canada, across Canada and thence via the Pacific station at Suva to Australia.

The operation of the Ottawa municipal electric light and power plant, during the past year, has been so successful from the financial standpoint, that the Electric Commission will probably recommend to the Council a reduction of from ten to fifteen per cent in the prices now charged consumers for light. Should the municipal plant reduce its rates, the Ottawa Electric Company will likewise make a similar reduction, so there will be a lowering of the charges all round.

It is the intention of the management of the Canadian Pacific Railway to install, during the year 1911, another 2,000 miles of telephone to replace the telegraph in the operation of trains. The amount of mileage already installed is given as 2,254 miles, the circuits in different parts of the system ranging from a little over a hundred to something over three hundred miles. It is pointed out, in connection with telephone equipment for the operation of trains, that the management is giving its attention in this respect to the single track, for where there is double track there is, under ordinary conditions, greater safety in working, and it has been found that the telephone operates on the side of greater safety as well as higher efficiency. W.

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

The Public Service Commission has ordered a conference to be called of the general managers, district superintendents, train dispatchers and master mechanics of the several interurban railroads in the state, to be held at Syracuse on January 19 for discussing all questions in relation to the safety of operation of these railroad companies. The attention of the Commission has been called to a number of serious accidents on interurban railroads, which, so far as investigations have developed, were caused by defective methods of operation, defects in block signals, or violations of rules or orders. The electrical expert of the Commission, Charles R. Barnes, is preparing a programme of subjects, which will be assigned to various interurban electric railroad officials for discussion.

The joint reorganization committee on December 29 filed with the Public Service Commission a petition asking the approval of a plan or reorganization of the Metropolitan Street Railway Company, of New York City. This plan has been prepared by the joint committee with the sanction and co-operation of the committee representing the five-per-cent general mortgage bonds and the committee representing the four-per-cent refunding mortgage bonds of the Company.

The total present outstanding securities and obligations of the Metropolitan Street Railway system are about $136,000,000, and this amount does not include the outstanding securities of certain collateral companies which were used to aid in financing the system, such as the New York City Railway and the Metropolitan Securities Company.

The plan provides for securities, including the new securities provided to be issued and old securities left undisturbed, to a total amount of about $96,000,000, which is a reduction of about $40,000,000 in the present outstanding securities and obligations.

The fixed charges representing the interest on the bonds which have been adjusted under the plan have been reduced by an amount exceeding $1,000,000 per year.

The new securities to be issued are approximately as follows: $11,768,000 new fixed-charge four per cent bonds; $39,000,000 new adjustment income bonds; $14,000,000 of stock.

It is estimated that the net earnings of the company after setting aside a depreciation fund will be sufficient to pay immediately from two and one-half per cent to three per cent on the adjustment income bonds.

The Public Service Commission has entered an order effective February 1, 1911, prescribing rules and regulations to govern after that date the practice of gas and electrical corporations and exacting cash deposits from consumers. Correspondence received at the office of the Commission has disclosed that many patrons of such corporations are ignorant of the provisions of law pursuant to which such deposits are exacted. Accordingly an inquiry was made by the Commission into the practice, disclosing an entire absence of such proper rules upon the part of the corporations, the observance of which would inform the depositor as to his rights in the transaction and safeguard his interests. The order is designed to correct these conditions.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

The City of Whitewater filed a complaint with the Commission alleging that the Whitewater Electric Light Company has not in the past and is not at present furnishing arc lights of the standard illuminating power of 2,000 candlepower each, with 432 watts of electrical energy, as agreed and required by the terms of the contract existing between the City and the Company. After a careful investigation of the operating statistics and expenses of the plant the Commission found that the cost per lamp, including taxes, depreciation and interest on the investment, was about $90 per year, which is higher than the price now paid by the City. It was found necessary to estimate to a large extent the output and demand of the plant. For forty-seven electric utilities operating in the state having from 200 to 500 consumers, the average connected load per consumer was 1.03 kilowatts, and the average ratio of demand to connected load was about forty-five per cent. A summary of the statistics of all the electric plants in the state operating in towns of 2,000 to 4,000 inhabitants showed the following average results: Average number of consumers, 288; average capacity of plant in kilowatts, 200; average connected load in kilowatts, 242; average maximum demand on station, 115 kilowatts, and average total operating expenses, not including taxes, depreciation and interest, $5,904.48. The Commission found the terms of the contract between the City and the Company were impossible of enforcement and the Commission commented on the 2,000 candlepower provision as follows: "The extracts quoted above are sufficient to show that the term '2,000 candlepower in the contract between the parties to this case is merely a nominal rating and does not represent the actual amount of light given and that the provision of the contract providing for the City deducting a certain sum in case lamps do not reach the stated illuminating power is practically impossible of enforcement." Wattage tests made by the Commission's inspectors showed the lamps in Whitewater to be deficient and the Commission ordered the Company to make such readjustments in its lamps and other equipment as to supply and maintain 432 watts of electrical energy at each of its arc lamps during the time these lamps are in actual use.

The annual report of the Commission for the year ending June 30, 1910, has been filed with Governor Davidson and urges the necessity for more comprehensive legislation if the Commission is to accomplish its highest purpose, particularly with respect to the law in regard to the issuing of stocks and bonds by the public service corporations of the state. Further strengthening of the law is urged by the Commission, under which the Legislature should describe the purpose for which securities should be issued, determining the character and limiting the amount which should be reasonably required and leave to the Commission to ascertain whether the proposed purposes are within the terms of the statute and whether the character and the amount proposed to be issued are reasonably required by the utility. Special emphasis is laid on the necessity for conferring the broadest powers of investigation upon the Commission. The report is a voluminous document and is largely devoted to statistics and figures showing the work of the Commission for the year covered by the report. The number of utility corporations, water, gas, electric light, power, etc., increased from 847 to 851. Of this number 199 were electric utilities with an increase of twenty-seven; 506 were telephone utilities with a decrease of twenty-three, which was due to the exclusion of a number of private mutual lines which had previously been listed as public utilities. The report says that electric utilities have increased their operating revenues by twenty per cent; their net income by twenty-nine per cent; and their new construction by 145 per cent. Similar, though not as large increases, are noted in all the other utilities in the state. The number of utilities which surrendered their franchises during the year and received indeterminate permits from the Commission numbered seventy-two. The Commission notes that during the year but two appeals have been taken to the Supreme Court from decisions of the Commission. The report complains of a lack of compliance with the statute requiring uniform accounting systems on the part of municipally operated plants. On the other hand, the Commission notes the increasing number of informal complaints and revisions of rates and the growing tendency on the part of municipalities to submit their rate schedules to the Commission for informal investigation and revision.

Tables which were gathered by the Railroad Commission of Wisconsin show rates in the small towns of the state, Table I. showing the rates on a basis of burning for a definite period every night, and Table II. shows towns using variations of the moonlight schedule. These tables are printed herewith.

TABLE I.

COMPARISON OF RATES FOR MUNICIPAL LIGHTING SERVICE.

Community.	Population.	Schedule.	Estimated hours burning.	Rate per year.	Rate per lamp hour (cents).
Bloomer	1,046	Dawn	4,000	12.00	.3
Delavan	2,321	Dawn	4,000	24.00	.6
Durand	1,559	Dawn	4 000	12.00	.3
Elkhorn	1,818	Dawn	4,000	36.00	.9
Frederic	683	Midnight	2,200	12.50	.569
Glenwood	905	Midnight and 5:30 a. m.	2,300	12.00	.522
La Farge	827	11:00 p. m. and early morning in winter	2,280	12.00	.526
Manawa	881	Midnight and 5 a. m. to dawn	2,650	13.20	.498
Necedah	1,116	Midnight and dawn	2,200 and 4,000	12.00	.545 and .3
Pardeeville	866	Dawn	4,000	15.00	.375
Waterford	800	Dawn	4,000	18.00	.45
Wyocena	400	11:30 p. m. and 4:30 to dawn	2,600	12.00	.461
Mt. Horeb	1,003	Dusk to 11 p. m., 11:30 Saturdays	1,825	12.00	.658
Average lamp-hour rate, every-night basis					.488 cents

TABLE II.

COMPARISON OF RATES FOR MUNICIPAL LIGHTING SERVICE.

Community.	Population.	Schedule	Estimated hours burning	Rate per year	Rate per lamp hour
Alma	1,172	Midnight	1,020	12.00	1.18
Algoma	2,008	Dawn	2,125	12.96	.61
Augusta	1,426	Midnight	1,020	12.00	1.18
Bangor	695	Midnight	1,020	27.00	2.64
Barron	1,674	1 a. m.	1,220	6.00	.491
Cashton	673	11:15 p. m.	870	24.00	2.76
Chetek	950	Dawn	2,125	15.00	.706
Cumberland	1,493	Dawn	2,125	12.00	.565
Delavan	2,321	Dawn	2,125	18.00	.847
Edgerton	2,416	Dawn	2,125	24.00	1.13
Fountain C.	1,008	Dawn	2,125	21.60	1.017
Glenwood	687	Dawn	2,125	9.00	.423
Lake Mills	1,602	Dawn	2,125	15.00	.706
Maxomania	863	11:30 p. m.	930	12.00	1.291
Mondovi	1,450	11:30 p. m.	930	16.20	1.743
N. Freedom	578	11 p. m.	825	16.00	1.938
Omro	1,300	Midnight	1,020	14.40	1.41
Peshtigo	2,539	Dawn	2,125	10.00	.471
Randolph	1,004	11 p. m.	825	9.00	1.091
Seymour	1,118	Midnight	1,020	14.50	1.42
Soldiers Gr.	718	11 p. m.	825	12.00	1.455
Sun Prairie	1,086	Midnight	1,020	21.00	2.028
Mt. Horeb	1,003	Dusk to 11 p. m., Saturday	840	12.00	1.428
Average lamp-hour rate, moonlight basis					1.23 cents

LIGHTING AND POWER.

(Special Correspondence.)

REDFIELD, IOWA.—The installation of an electric light plant is being agitated. C.

OSLO, WIS.—The Oslo Power & Light Company has been incorporated with a capital stock of $5,000. P.

STRATTON, NEB.—At a special election held recently it was voted to install a municipal electric light plant.

GILTNER, NEB.—Bonds have been voted for the establishment of an electric light and waterworks system. P.

HUSTISFORD, WIS.—The Hustisford Electric Light & Power Company has been granted a franchise to operate here.

MARINETTE, WIS.—Senator Stephenson is planning to develop 6,000 horsepower from Chappie Rapids four miles north of here. C.

CARRINGTON, N. D.—The Western Electric Company has applied to the Council for a franchise to install an electric light plant.

ADAIR, IOWA.—Citizens of Adair voted at a special election to have the municipality build an electric lighting plant costing $10,000. Z.

LIBBY, MONT.—The Libby Waterworks, Electric Light & Power Company has been incorporated with a capital stock of $350,000. P.

JOLIET, ILL.—A new wiring system of the Joliet Theater, it is announced, is part of the plans of the new owner James C. O'Connor. C.

KAUKAUNA, WIS.—It was decided at a special election that the City should buy the plant of the Kaukauna Gas & Electric Company.

FORBESTOWN, CAL.—Early in the year, a power plant is to be erected on the Garibaldi Mining property by the Garibaldi Mining Company. A.

STANDISH, MICH.—The light plant here has been sold to Guy H. Winterstee and Bruce W. Garton. The new owners took possession January 1.

DES MOINES, IOWA.—The Avoca Electric Light & Power Company has filed articles renewing its incorporation for a period of twenty years.

ATLANTIC, IOWA—This city has voted $50,000 in bonds for the construction of an electric light plant in connection with the waterworks plant. P.

HAMBURG, IOWA—The E. B. Hillman Electric Light Company has been given a twenty-year franchise extension, and will improve its plant. P.

NORTH YAKIMA, WASH.—The Pacific Power & Light Company is planning extensions to its system during the coming year aggregating $1,750,000. C.

EAST TROY, WIS.—The village board is considering a proposition by the Milwaukee Electric Railway & Light Company to install an electric system. C.

BRAINERD, MINN.—The Totz Engineering Company, St. Paul, of which W. E. King is superintendent, has commenced the construction of the electric light and power plant. C.

EAST ST. LOUIS, ILL.—The City Council has passed an ordinance allowing the East St. Louis Light, Heat & Power Company to extend its lines into new territory in the city. Z.

SHAKOPEE, MINN.—The superintendent of the electric light plant has prepared plans for an engine-driven pump to be installed in the power house. Bids will be opened January 10. C.

DENVER, COLO.—The Ellis National Electric Light Company has been incorporated with a capital of $1,000,000. The incorporators are A. L. Hiller, J. H. Stahl and M. McCullough.

SILVER CITY, N. M.—The Gila River Power Company has obtained rights for the water in the Gila River in Western Grant County. The Company plans to develop 15,000 horsepower. A.

DAYTON, O.—The improvements which are being made by the Dayton Lighting Company will be finished about February 1. In the past six months the capacity of the plant has been doubled.

IRONTON, MINN.—The Minnesota Canal Power Company, of Duluth, is planning the construction of an 80,000 horsepower electrical power plant to supply electric power to Superior and Duluth. C.

SANTA ROSA, CAL.—The Sonoma Valley Water, Light & Heat Company has been incorporated by E. M. and Edna L. Hoen of Sacramento and L. L. and Mabel Lewis of El Verano, Cal., with a capital stock of $100,000.

FERGUS FALLS, MINN.—The city is considering the advisability of installing a steam turbine or gas engine plant for the city electric lighting system. The cost of rebuilding the power dam is estimated at $72,000. C.

COLLINSVILLE, ILL.—The Collinsville Electric Light Company has let the contract for the erection of its new power house to Thomas Sauer. The City probably will add more arcs to its street illumination system when the new work is compieted. Z.

SALISBURY, N. C.—The Whitney Electric Power Plant in Staley County, was sold at auction for $90,250 to the North Carolina Electric Power Company, which, it is reported, has $2,000,000 capital for the completion of building plan of the original company.

COGGON, IA.—A special election was held last spring, and a special tax was voted for the erection and maintenance of an electric light plant. An investigating committee has now been appointed and steps are to be taken shortly toward the erection of the plant.

BRYANT, S. D.—The business men have subscribed a fund of $3,000 which has been loaned to the town, and which will be used to install an electric light system here. The plant will be installed as soon as possible, preliminary work already having commenced.

FORT STOCKTON, TEX.—The County Commissioners have granted Clay Brothers, of San Angelo, a ten-year franchise for an ice factory and electric light plant for Fort Stockton. Under the contract with the Commissioners the improvements must be in operation by July 1, 1911.

RAPID CITY, S. D.—The Dakota Power Company has purchased all the property of the Rapid City Power Company, eliminating competition in the central hills. The consideration is $150,000. When the consolidation of the plants is completed it will have a capacity of 7,500 horsepower.

NASHVILLE, TENN.—The Secretary of State has issued a charter of incorporation to the Citizens Electric Light & Power Company of Madison County, with a capital stock of $1,500. The incorporators are T. E. Mercer, Eugene Davis, M. B. Mulherron, J. M. Justice and W. Ragland. I.

GROVELAND, CAL.—The entire holdings of the Tuolumne River Power Company have been sold to a syndicate of eastern capitalists. Lester R. Wiley will retain his interest in the Company and remain manager. The first development work of the new company will begin early in March. A.

CHADRON, NEBR.—The City Council has granted the lighting franchise for twenty years to Kass & Klingaman, reserving the right for the city to buy at the end of ten years. Kass & Klingaman lately purchased the electric light plant and expect to put in many improvements to the building and machinery.

GALESBURG, ILL.—The City Council decided to purchase a mercury arc rectifier for the purpose of utilizing electricity from the plant of the McKinley interests for street lighting while new machinery is being installed at the municipal lighting and water pumping plant. It was decided to expend $1,100 or $1,200. Z.

IDYLLWILD, CAL.—The Ramona Power Company has purchased a power site several miles south of here. This company is reported to have obtained practically all the water rights in the north and south forks of Strawberry Creek. The new power house of the Company to be erected next year is to be located in San Jacinto Canyon. A.

SEYMOUR, IND.—A reorganized company of stockholders headed by Frank R. Grover, William Claney and Theodore Durst of Chicago, has purchased for $20,000 the Seymour Gas & Electric Light plant. It will make extensive improvements and operate the system. The new company has also purchased the franchise of the Public Service Company and will have a monopoly of the lighting business in Seymour. S.

MITCHELL, IND.--The municipal electric light plant owned by the City has been sold to Samuel D. Rowland, the consideration being $7,301. The City built and equipped the plant about fifteen years ago and has been a losing proposition until recently. Mr. Rowland, the purchaser, has received a franchise to supply water and will construct a plant to supply water at once. He will also improve and add some new equipment to the electric plant. S.

RENO, NEV.—The Truckee River General Electric Company, of which J. B. Lukes is local manager, has completed all its surveys and drawings for the building of a new power plant and has let some of the contracts. The Company will first build a dam across the Truckee River near the Reno Country Club and at a point a short distance from Verdi, Nev., will build a new power plant which will generate 3000 horsepower. Among other uses, this power will supply the smelter at Mason City and Waubuska and operate the mines in Yerington. A.

MONTGOMERY, ALA.—The Montgomery Light and Water Power Company is preparing to spend $350,000 on its electric plant at Tallassee, which is a short distance from this city. Expert engineers are drawing the plans for improvement, and as soon as these are submitted work will begin. The Company proposes to double the capacity of its plant, which has become necessary from the increase in consumption of electricity during the past year. Two additional turbines, each of a capacity of 3,000 kilowatts, will be installed, and other important improvements will be made. New power cables to handle the increased current will also be run. The increase of consumption in Montgomery of electricity furnished for all purposes during the past year has been more than one-third of the entire consumption of 1910. It is announced that the plans and specifications will be ready within two months, at which time the work will begin. I.

ELECTRIC RAILWAYS.

(Special Correspondence.)

SIOUX CITY, IOWA.—The Commercial Club will promote the construction of the electric road to Spirit Lake. C.

MANKATO, MINN.—Mr. Cummings, of Chicago, is promoting the construction of an electric line, twelve miles long, to St. Peter. C.

TACOMA, WASH.—The Tacoma Railway & Power Company will apply for a franchise to construct its lines to Bismark, at an estimated cost of $25,000. C.

HIBBING, MINN.—The Duluth Engineering Company has commenced the survey of an electric line to Chisholm for the Mesaba Electric Railway Company.

VIROQUA, WIS.—The LaCrosse & Southeastern Railroad Company has started a survey for a line, fifteen miles long, to Retreat, which it is proposed to build next summer. C.

FLANDREAU, S. D.—The St. Paul Railroad Company has completed arrangements for the construction of an electric road to Ortonville, Minn., and work will be started in the spring. C.

MINNEAPOLIS, MINN.—It is reported that the Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Company will build a power house as soon as the present work on its lines is completed.

OKLAHOMA CITY, OKLA.—The Oklahoma Street Railway Company has begun the erection of a new repair shops and car barn to cost $75,000. The power plant at Belle Isle is to be doubled in capacity necessitating an expenditure of $125,000. Z.

TOLEDO, O.—The Toledo Railways & Light Company broke all December records on December 24, when 210,000 people were carried on its lines. With two exceptions all records were broken. The week preceding Christmas about 700,000 fares were collected by this Company. H.

OKLAHOMA CITY, OKLA.—In order to determine the sentiment of patrons upon the innovation of having cars stop only at every other corner and improving the schedule thereby, the Oklahoma Railway Company has been having men distribute cards bearing space for a statement of opinion concerning this move, among the passengers. Z.

NASHVILLE, TENN.—An interurban railway line is soon to be constructed between Nashville and Gallatin at a cost of about $750,000. The line will traverse one of the richest and most populous sections in Tennessee. Surveyors will soon be in the field and the actual construction of the line will begin not later than May. I.

ST. LOUIS, MO.—The St. Louis Electric Terminal Railway Company which owns the buildings, bridge and ground in St. Louis, of the McKinley System, has filed notice of an increase in capital stock from $1,000,000 to $2,000,000. This is said to be the first legal steps toward the erection of the new thirteen-story passenger station at Twelfth Street and Lucas Avenue. Z.

BIRMINGHAM, ALA.—Mayor Culpepper Exum, of Birmingham, has signed an ordinance granting to the Tidewater Railroad Company the privilege of constructing a street car line from East Lake to Bessemer, the period of the franchise being for ninety-nine years. The requirements are that the Company shall begin construction immediately and that they shall complete the line within two years.

GUTHRIE, OKLA.—The Oklahoma Short Line Edectric Railway Company, with headquarters at Shawnee, has been incorporated to build electric lines from Oklahoma City to Joplin, Mo., a distance of 175 miles, and from Shawnee to Denison, Tex., a distance of 125 miles. The capital stock is $100,000. The incorporators and directors are: C. Wright, Ada, Okla.; M. J. Bentley, Tucumseh, Okla.; Leroy Paddock, Oklahoma City, Okla.; Z. V. Sanders, Albermarle, S. C., and Thomas Warmantrout, Kirkwood, Mo. Z.

ST. PAUL, MINN.—The St. Paul Railway Promotion Company has had surveys prepared for electric roads to Mankato, via Wescott, Rosemont, Farmington, Castle Rock, Northfield, Dundas, Bridgewater, Faribault, Cannon Lake, Wausaw, Morristown, Waterville, Elysian, Greenland, Madison Lake and Eagle Lake, and to Lake City via Burlington, Red Rock, Newport, St. Paul Park, Hastings, Etter, Eggleson, Red Wing, Wacouta and Frontenac. A survey is also proposed between Red Wing and Lake City via Rochester. C.

LOS ANGELES, CAL.—Orders have been issued by Paul Shoup, vice-president in charge of the operations of the Pacific Electric and Los Angeles-Pacific Companies for the conversion of the Southern Pacific line from Los Angeles to Palms into an electric road. That part of the line between Palms and Santa Monica was converted some time ago. A trolley wire will be strung over the old Southern Pacific tracks from Palms east through Sentous and University to Clement Junction, where the four-track Long Beach line of the Pacific Electric is reached. From there the line will run north to the Arcade station and the Pacific Electric's station at Sixth and Main Streets. Over this line all freight for the Santa Monica Bay district, whether it comes by land or water, will be transported. A.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

PE ELL, WASH.—A franchise has been granted to H. W. Weller for the installation of a municipal telephone system. C.

HETTINGER, N. D.—The construction of a farmers' telephone line through Bison, S. D., and other towns in Perkins County is projected. C.

MISHICOT, WIS.—The Mishicot Telephone Company, capital $2,600, has been incorporated by A. Holst, August Rhode, P. Boniller and others. C.

FREMONT, WIS.—George Dobbins and others have organized a telephone company to put in a local exchange and extend the lines to Poysippi and Weyauwega exchanges. C.

CRYSTAL, IND.—The Columbia Telephone Company has incorporated to build and operate a telephone system in Crystal and Dubois County. E. E. Ellis is president. S.

NEW CONCORD, KY.—The Blood River Telephone Company has been incorporated with a capital of $700. The incorporators are J. T. Burton, W. H. Curd, J. T. Mitchell.

ELK CREEK, WIS.—The Elk Creek Telephone Company has been incorporated with a capital of $8,000. The incorporators are W. A. Warher, A. M. Thompson and Luke Roskes.

BUXTON, N. D.—The Red River Valley Telephone Company has increased its capital stock from $100,000 to $200,000, for the purpose of making further extensions to its toll lines. C.

FREMONT, WIS.—The Fremont Telephone Company has been incorporated with a capital of $7,000. The incorporators are George H. Dobbins, W. E. Sherburne and W. J. A. McIntyre.

INDEPENDENCE, IOWA.—It is reported that the two telephone exchanges here will be united about April 1, and that the business will thereafter be conducted from the Corn Belt exchange.

FULLERTON, KY.—The Fullerton Home Telephone Company has been incorporated with a capital of $1,200. The incorporators are John Arthur, J. R. Shepboard, Mary Fullerton and Lyman Warnock.

WAWAKA, IND.—The Peoples' Mutual Telephone Company is the name of a company just organized to build an exchange in Wawaka and extend the lines throughout Noble County. The initial capital is $2,500. The incorporators are John Reidenbach, Braden Franks and William Weaver. S.

FRESNO, CAL.—Early in the year the Fresno telephone system is to be extended to the northwestern portion of this city. Among other improvements, more underground cables will be laid in the downtown district. These will not displace the present overhead wires but will add to the system.

ALTON, ILL.—The Central Union Telephone Company has a force of twenty-five men rebuilding lines here and it is probable that the men will be occupied until spring. Features of the rebuilding will be stringing a 400-pair cable and a fifty-pair cable. Switchboard facilities also will be enlarged. Z.

INDIANAPOLIS, IND.—The Interstate Telephone Company, capitalized at $75,000, has been incorporated. The Company's purpose is to merge and operate a number of existing telephone lines in Davies and Green Counties. Five exchanges will be taken over by the new company and improvements, extensions and betterments made at once. The directors are O. E. Pattorf, K. P. Knight, J. G. Paul and E. A. Coulter. The principal office will be maintained in Indianapolis. S.

ELECTRICAL SECURITIES.

A general dullness with a tendency to higher prices was the characteristic feature of the last week of 1910. On the other hand a number of stocks are lower than at the same time a year ago, and the leading copper and smelting stocks show a decline of about thirty points. Such a period of dullness, restricted production and economy as that through which the country has been passing usually prepares a basis for a new forward movement. It is possible this may not start until the uncertainty attending the questions now before the Supreme Court and the Interstate Commerce Commission is removed, but the worst is probably over and the country without waiting for the decisions is liable to start off upon a new period of prosperity.

The Old Colony Street Railway has petitioned the Massachusetts Railroad Commission for approval of issue of 3,000 additional common shares, to be offered proportionately to stockholders at $100 a share.

DIVIDENDS.

Bell Telephone Company, of Pennsylvania, regular quarterly dividend of one and one-half per cent payable January 16 to stock of record January 5.

Boston Suburban Electric Company regular quarterly dividend of $1 per share on the preferred stock, payable January 15.

Manchester Traction, Light & Power Company, quarterly dividend of $2, payable January 16.

Minneapolis General Electric Company, quarterly common dividend of one and three-quarters per cent, semiannual preferred dividend of three per cent, both payable February 1.

Northwestern Elevated Railroad, quarterly preferred dividend of one per cent, payable January 18.

Ottawa Light, Heat & Power, preferred extra dividend of two per cent.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Jan. 2.	Dec. 26.
Allis-Chalmers common	8	8⅛
Allis-Chalmers preferred	27	29
Amalgamated Copper	61½	62½
American Tel. & Cable	*78	*78
American Tel. & Tel.	140	142⅛
Brooklyn Rapid Transit	74⅞	75¼
General Electric	151¼	154
Interborough-Metropolitan common	19½	19¼
Interborough-Metropolitan preferred	53½	54
Kings County Electric	123	123
Mackay Companies (Postal Telegraph and Cables) common	90	90½
Mackay Companies (Postal Telegraph and Cables) preferred	74¾	74⅝
Manhattan Elevated	138½	137½
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	43½	43¾
U. S. Steel common	72⅛	72⅛
U. S. Steel preferred	116⅜	116⅝
Western Union	72½	72¾
Westinghouse common	65½	66½
Westinghouse preferred	115	115

*Last price quoted.

BOSTON.

	Jan. 2.	Dec. 26.
American Tel. & Tel. (ex dividend)	140¼	142
Edison Elec. Illuminating	280	280
General Electric	151¼	154
Massachusetts Electric common	18	18
Massachusetts Electric preferred	85	85
New England Telephone	138	137¾
Western Tel. & Tel. common	17	17
Western Tel. & Tel. preferred	91½	90¼

PHILADELPHIA.

	Jan. 2.	Dec. 26.
American Railways	42	42½
Electric Company of America	11⅝	11⅝
Electric Storage Battery common	48	47½
Electric Storage Battery preferred	48	47½
Philadelphia Electric	16	16⅛
Philadelphia Rapid Transit	18⅜	18¼
Philadelphia Traction	82½	84
Union Traction	43	42⅞

CHICAGO.

	Jan. 2.	Dec. 26.
Chicago Railways, Series 1	97	92
Chicago Railways, Series 2	25	24½
Chicago Subway	4½	4
Chicago Telephone	120	122½
Commonwealth Edison	113½	114
Metropolitan Elevated common	22½	21
Metropolitan Elevated preferred	68	65
National Carbon common	118	116
National Carbon preferred	115	115

PERSONAL MENTION.

T. C. KINGSBURY, of N. W. Harris & Company, Chicago, became a vice-president of the American Telephone & Telegraph Company the first of the year.

FRANK ARNOLD, superintendent of the Fort Dodge, Des Moines & Southern interurban railroad, has handed in his resignation and will sever connections with the company on February 1.

COL. GEORGE W. GOETHALS, chief engineer of the Panama Canal, will deliver an illustrated lecture on the canal work before the National Geographic Society, Washington, D. C., on January 27.

WILLIAM C. SPARKS has succeeded Chester P. Wilson as general manager of the Rockford & Interurban Railroad Company. Mr. Sparks has for the past ten years been chief engineer of the Indiana Union Traction Company.

RICHARD TILLIS, president of the Montgomery Traction Company, of Montgomery, Ala., has been named as successor to Alex Rice, who recently resigned from the presidency of the Citizens' Light, Heat & Power Company of Montgomery.

CLARK F. ROSS, who for some time has been connected with the Commonwealth Edison Company, at the Electric Shop, in the capacity of assistant to the manager, has recently accepted the position of advertising manager for the Pelouze Electric Heater Company, Chicago, Ill.

GEORGE B. DUSINBERRE, who was formerly in charge of the Cleveland office of the American Electric Fuse Company, has been placed in charge of the New York office to take the place of W. B. McCurdy, who resigned. Mr. Dusinberre has had a wide experience in practical engineering and in selling, and is especially competent to furnish technical advice.

HON. JOHN MacVICAR, who is one of the best known authorities on all that pertains to municipal affairs, has been selected for the position of Commissioner-General of the International Municipal Congress and Exposition, which is to be held in Chicago September 18 to 30. Mr. MacVicar has been in active service in municipal work for more than twenty years and has for fifteen years been president of the League of American Municipalities.

EDWARD DANIEL MEIER, who was elected at the recent annual meeting of the American Society of Mechanical Engineers as president of that society is one of the best known men in this country, in the mechanical engineering field. Mr. Meier's first studies in science were carried on at Washington University, St. Louis, and were later continued at the Royal Polytechnic School at Hannover, Germany. He then took an apprenticeship course at Mason's Locomotive Works at Taunton, N. J., later serving in the United States Army. He has been intimately associated with a number of engineering and manufacturing projects, and was responsible for the introduction of the Diesel motor into the United States.

OBITUARY.

WALTER DeFOREST BROWN, secretary and treasurer of the tional India Rubber Company, Bristol, R. I., died on Friday, December 9, 1910.

FRANK M. GREENE, for forty-two years connected with the Western Union Telegraph Company, at Toledo, died at his home of heart disease. Mr. Greene was born in Oneida county, N. Y., and came to Toledo in 1858. He entered the employ of the Western Union as clerk and worked his way up to the position of cashier and finally manager.

DR. J. F. DEEMER, a prominent street railway man, and director of the Toledo Railways & Light Company, died recently at his home in Levis, a suburb of Quebec, Canada. Death resulted from a severe cold which developed into hemorrhages. He was general manager of the National Telephone Company, president of the Telephone Association, and prominently connected with a number of other corporations. His death following the recent resignation of William B. Hale of Chicago, leaves two vacancies in the directorate of the Toledo Railways & Light Company.

A. C. SANDS, who retired a short time ago from the active management of the Western Washington section of the Sunset Telephone Company, died recently in Seattle, Wash., owing to a nervous breakdown which extended over a period of two years. Mr. Sands came to Tacoma in 1884 and entered the service of the Sunset Telephone Company as local manager, later rising to the position of district manager for western Washington. He had charge of the construction of the telephone lines of the Company in Alaska in 1898. Mr. Sands retired from business last April. He is survived by a widow and two brothers.

NEW INCORPORATIONS.

CLEVELAND, O.—The Enterprise Electric Fixture Company has been incorporated with a capital of $10,000 by A. Oppenheimer, Edward Younger and others.

PERU, IND.—The Peru Electric Company has been incorporated with capital stock of $100,000 to manufacture electrical supplies. The incorporators and directors are W. H. Zimmerman, J. H. Miller and John Cramer. Z.

PEORIA, ILL.—The Peoria Electric Fixture Company has been incorporated with a capital stock of $2,400 to manufacture and deal in electric fixtures, supplies, etc. The incorporators are E. J. Abercol, John L. Palmer and A. G. Walsh.

CINCINNATI, O.—The E. A. Foy Company, has been incorporated to manufacture lightning rods and electrical appliances. The capital is $75,000 and the incorporators include E. A. Foy, Mary A. Foy, William F. Foy, R. E. Heekin and C. T. Burdge.

PROPOSALS.

POST OFFICE, ROSWELL, N. M.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until February 2 for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Post Office and Court House at Roswell, N. M., in accordance with drawings and specification, copies of which may be had from the custodian of site at Roswell, or at the Supervising Architect's office.

POST OFFICE, MOUNT CLEMENS, MICH.—The office of the Supervising Architect, Washington D. C., will receive sealed bids until February 6 for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States Post Office at Mount Clemens, Mich., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Mount Clemens, or at the the Supervising Architect's office.

POSTOFFICE, STEVENS POINT, WIS.—The office of the supervising architect, Washington, D. C., will receive sealed bids until January 25 for the construction complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States postoffice at Stevens' Point, Wis., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Stevens Point, Wis., or at the supervising architect's office.

POST OFFICE, SALT LAKE CITY, UTAH.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until February 3 for the extension, remodeling, etc., (including plumbing, gas piping, heating apparatus, electric conduits and wiring system), of the United States Post Office and Court House at Salt Lake City, Utah, in strict accordance with the drawings and

specification, copies of which may be obtained from the custodian at Salt Lake City or at the Supervising Architect's office.

NAVY DEPARTMENT SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on naval supplies on the dates given below. Bidders interested therein should make early application for copies of the schedule, giving the schedule numbers desired. Schedules can be obtained from the Navy Pay Office nearest each navy yard. Bids will be asked on the following supplies:

Date of Opening	Article.	Quantity.	Place of Delivery.	Schedule No.
Jan. 17...	Generator sets	18	Various	3232
	Indicators, helm, electrical.		Norfolk, Va.	3243
	Telegraphs, steering	2	Norfolk, Va.	3243
	Transformers	200	Various	3232
	Wire, lighting	4,500 feet	Brooklyn, N. Y.	3243
Jan. 24...	Winch, deck, electric	1	Norfolk, Va.	3247

INDUSTRIAL ITEMS.

THE PITTSBURG TRANSFORMER COMPANY, Pittsburg, Pa., sent to its customers Christmas and New Year cards advertising the Pittsburg bell ringer.

H. W. JOHNS-MANVILLE COMPANY, New York, N. Y., describes a number of electrically heated medical devices in a booklet entitled "Heat as the Family Doctor." A list is also given of some of the diseases which the "J.-M. Electrotherm" cures and helps to cure.

THE REYNOLDS DULL FLASHER COMPANY, 152 Fifth Avenue, Chicago, Ill., has issued a folder illustrating and describing a number of big electric signs. The information is in such shape as to be of practical value to those interested. Copies may be secured upon request.

THE WILLARD STORAGE BATTERY COMPANY, Cleveland, O., has closed a standardization contract with the Harriman Lines for their requirements of train-lighting batteries. This contract was awarded to The Willard Company after a thorough service test of all makes of storage batteries, extending over a period of two years.

THE HOYT ELECTRICAL INSTRUMENT WORKS, Penacook, N. H., announces that the sales offices which have been maintained at 161 Summer Street, Boston, Mass., will be discontinued. Customers are requested to address their communications to the New York office at 136 Liberty Street or to the factory at Penacook, N. H.

THE NELSON VALVE COMPANY, Philadelphia, Pa., has distributed to its customers novel advertisements in the form of red danger-cards which may be attached to live exposed wires, valves which should not be tampered with and other dangerous pieces of apparatus. The cards will be sent by the Company on application to them.

THE WESCO SUPPLY COMPANY, St. Louis, Mo., has published its Catalogue No. 150. This is a particularly impressive volume of some thirteen hundred pages. The lists and descriptions of electrical goods are very comprehensive, and the illustrations are clear and well printed. It is just the book that the jobber and dealer in supplies need.

THE LOVELL-McCONNELL COMPANY, Newark, N. J., will hereafter handle all selling, shipping and billing of the Klaxon and Klaxonet warning signal, succeeding to the business of the Klaxon Company. W. O. Turner, who has been manager of the Klaxon Company, becomes secretary of the Lovell-McConnell Company, and will take entire charge of the sales and offices.

THE C. F. PEASE COMPANY, Chicago, Ill., is distributing a one-hundred-page catalog of blue-print machinery and drafting-room supplies. A full line of the Company's material is listed. Especial attention is called to the Pease direct-process white prints which may be quickly and easily made and which are especially valuable for material bills, lists, statistical matter, tabulations, etc.

DODGE, DAY & ZIMMERMAN, Philadelphia, Pa., have added to their organization Walter Loring Webb and James M. Kennedy. Both gentlemen are well known in the engineering world. Mr. Webb is the author of several engineering text books, including "The American Civil Engineers' Pocket Book," "Economies of the road Construction" and "Problems in the Use and Adjustment of Engineering Instruments."

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, describes and illustrates its three-wire generators in Bulletin No. 441, which was recently mailed to the trade. These generators are built as belted machines or for direct connection to any standard engine. Size range from twenty-five kilowatts up to any size desired, and windings are for 250 volts, so that 125 volts may be obtained from either side of the system.

THE NERNST LAMP COMPANY, Pittsburg, Pa., describes in a recent booklet the lighting of the F. A. O. Schwarz Store, New York City. This store, which is said to be the largest and finest exclusive toy store in the world, is lighted principally by the Duretta type Westinghouse Nernst lamp, as this conforms best to the general architectural features of the store. Diagrams showing the arrangement of the lamps are included in the booklet.

DOSSERT & COMPANY, New York, N. Y., have issued to the trade a new catalog in which the Dossert solderless connections are described. The Dossert connectors entirely eliminate the use of solder in making electrical connections and splices and are approved for use without solder by the National Board of Fire Underwriters. Each type of connecter is illustrated and a number of diagrams are given. Tables which were compiled show the proper sizes of connections for each size of wire.

THE AMERICAN ELECTRIC FUSE COMPANY, Muskegon, Mich., announces that its eastern offices, which have for nearly twelve years been located at 116 Nassau Street, New York, have been moved to the Hudson Terminal Building. A larger and more complete stock will be kept of "Blue Ribbon" telephone protectors, "American" enameled magnet wire, "Allen-Bradley" motor starters, controllers, battery-charging rheostats, and "Americoil" ignition apparatus. George B. Dusinberre wil be in charge of the office.

THE G. W. ARMSTRONG COMPANY, Chicago, manufacturers of the "Acco" hangers, Green Seal batteries and flash-light novelties, and which acts as exclusive distributor for a number of high-grade specialties, has moved its offices from the second floor of the Electrical Building to the main floor of the same building. The Company has added about 2,000 square feet to its floor space and still retains its loft on the second floor. Although this concern has been in existence only about four months, it has built up a big business, due, in a great measure, to its energetic president, G. W. Armstrong.

THE KELLER MANUFACTURING COMPANY, Philadelphia, Pa., has distributed booklets explaining the advantages obtained by the use of vacuum cleaners. One of these booklets, which describes the Keller-Duplex vacuum cleaner, for permanent installation, describes what is designated as a thoroughly efficient economical vacuum cleaning plant of one sweeper capacity. The appearance of the plant is shown by an illustration, and numerous other pictures give an idea of the methods of use of the cleaner motors for these cleaners are of one-quarter horsepower. The other booklet entitled "The Dustless Home" describes the Keller-Santo vacuum cleaner, which is smaller and is portable.

THE MACBETH-EVANS GLASS COMPANY, of Pittsburg, Pa., has prepared a fine book of views illustrating the application of Alba globes for ornamental street lighting. Ten full-page engravings, each 9 by 6 inches, show typical installations in Chicago, Boston, Minneapolis, Indianapolis and Gary with ornamental standards surmounted by single or clustered tungstens, inclosed magnetite and flaming arcs, the lamps being in each case equipped with Alba balls or globes. There are also shown fifteen different designs of ornamental standards for tungsten clusters by various makers. This book clearly demonstrates that the excellent diffusing qualities and high efficiency of Alba glass have been extensively recognized in the most representative installations of ornamental street lighting in this country.

THE EXCELLO ARC LAMP COMPANY has been obliged to seek larger quarters in order to keep pace with the phenomenal success of the Excello arc lamps in the West, since G. W. Armstrong, western manager of the Company, began pushing the lamps in this territory. The officers of this Company are now located on the main floor of the Electrical Building, Chicago, at the southeast corner of Jackson Boulevard and Desplaines Street. The loft on the second floor of the same building heretofore occupied by the Company, is maintained, but will be used entirely as an electrical department for reconstructing, repairing and maintaining Excello lamps. It is claimed that this department is equal to that of any lamp company in the country as this office takes care of all Excello lamps installed west of Pennsylvania. The new offices give the Company about 2,000 feet additional floor space.

ABELES & TAUSSIG, St. Louis, Mo., producers of and dealers in railroad ties and heavy timber, bridge and car timber, switch ties and crossing plank, poles and piling, cross-ties for steam and electric railways, announce that "some time ago the Government conducted an investigation as to the relative qualities of cedar and cypress with the following results. They found that a thirty-foot cedar pole, grown under natural forest conditions, would last about fifteen years on the average; and that the same size cypress would last about twelve years. Taking this, together with the fact that cypress is much cheaper than cedar, into consideration, also the diminishing quantity and inferior quality from year to year of cedar, in addition to the higher freight rates and limited area of supply, would certainly make the use of cypress to be recommended.

THE WESTERN ELECTRIC COMPANY has issued its House Goods Bulletin No 9550, listing complete lines of apparatus, appliances, tools and devices intended for everyday household use. This includes inter-phones for residences and office service, for private line telephone systems and for apartment house and vestibule use, annunciators dry batteries, Edison cells, "Hawthorn" bell-ringing transformers, pocket electrical instruments, burglar alarms, door and window springs and door openers, fire-alarm boxes and annunciators; electric heating devices, "Sunbeam" Mazda lamps, miniature lamps, Christmas tree outfits, Holophane reflectors, portable lights for a variety of uses, "Hawthorn" Mazdaliers, lamp cords, sockets and receptacles, pendant switches, plugs and current taps, tubular flashlights and pocket flashlights, small power motors, sewing machine motors, buffing and grinding machines, wash-

ing machines and suction sweepers; "Hawthorn" desk and bracket fans, ceiling fans and fan motor outfits; push buttons, "Hawthorn" floor treads, speaking tubes, whistles and mouthpieces; switches, telegraph apparatus, relays, arresters, toy battery motors, electrical toy outfits, "Hawthorn" watchmen's time detectors, etc.

DATES AHEAD.

Chicago Electric Show. Coliseum, Chicago, Ill., January 7-21.

Indiana Engineering Society. Annual meeting, Indianapolis, Ind., January 12, 13 and 14.

Electrical Contractors' Association of New York State. Annual meeting, Albany, N. Y., January 16.

Wisconsin Electrical Association. Annual convention, Milwaukee, Wis., January 18-19.

National Independent Telephone Association. Annual Convention, Chicago, Ill., January 18-19.

Canadian Electrical Association, Special general meeting, Toronto, Can., January 20.

Minneapolis Electrical show. Minneapolis, Minn., January 26-February 4.

Philadelphia Electric Show. Philadelphia, Pa., February 13-27.

Iowa Electrical Association. Annual meeting, Davenport, Iowa, April 19, 20 and 21.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) December 27, 1910.

974,404. SELECTING DEVICE. Frank G. Agrell, Stockholm, Sweden. Filed February 27, 1907. Three electromagnets are arranged so that their armatures form a triangle adapted to make selective contact with a rotating contact-maker.

979,405. FAN-SUPPORT. Frank Andrus, Chicago, Ill., assignor of one-half to Montezuma Scott, Chicago, Ill. Filed December 13, 1909. In front of an electric fan is a bladed wheel whose rotation actuates an oscillating mechanism in the base.

979,428. ELECTRIC-LAMP SOCKET. Howard B. Chandler and James A. Fleet, Portland, Me. Filed August 28, 1908. Renewed September 8, 1910. An adapter socket has a detachable angle piece between the cap and shell.

979,448. RAIL-BOND. Robert L. Dunivant, Fort Worth, Tex. Filed February 7, 1910. A bond for the third rail of an electric line has disks at each end fitting into the top of a socket at each end of a clamp under the rail ends. Coiled springs in the sockets press the bond against the rail.

979,455. HEATER AND GLOWER RENEWAL FOR SECOND-CLASS-CONDUCTOR LAMPS. Otto Foell, Anton Kusebauch, and Roy Neckerman, Pittsburg, Pa., assignors to Nernst Lamp Company, Pittsburg, Pa. Filed November 11, 1908. The heater support has prongs for removably securing it to the base of the glower and for electrically connecting the heater to the lamp terminals.

979,458. SAFETY-GATE. George R. Freak, Chicago, Ill., assignor of one-half to John Roberts, Chicago, Ill. Filed November 22, 1909. A vertically movable gate has racks geared to electric motors for automatically operating it.

979,459. ELECTRIC STREET-LIGHTING. Carl Henry Froelich, St. Louis, Mo. Filed July 5, 1910. A combined socket and street hood for incandescent lamps has insulator-bearing arms and an inclosed socket.

979,464. LIGHTNING-ARRESTER. William R. Garton, Chicago, Ill., assignor to Charles J. Griffin, Montezuma, Iowa. Filed November 11, 1907. Consists of separated carbon terminals, an interposed body of comminuted, hygroscopic substance, contacting with one terminal and insulated from the other, and an asbestos casing surrounding the body.

979,465. METHOD OF TREATING CARBON ELECTRODES. Walter Gaston, New York, N. Y. Filed March 9, 1910. A method of preventing cracking in electric carbons while in use consists in subjecting the hot electrode as it comes from the baking furnace to the action of a hot solution of boiling tar and pitch, and allowing the electrode to become thoroughly saturated with the solution.

979,467. TELEPHONE-MOUTHPIECE. George William Gibberd and Owen Aubrey Elias, London, England. Filed May 28, 1909. Has a refillable antiseptic container in a sleeve between the mouthpiece and transmitter.

979,475. PULL-SOCKET FOR ELECTRIC LAMPS. Gilbert W. Goodridge, Bridgeport, Conn., assignor to Bryant Electric Company, Bridgeport, Conn. Filed July 30, 1908. A switch block, and operating spindle in combination with a ratchet disk secured to the spindle with an insulating face adjacent to the switch block and a transverse slotted pawl slide guided by the spindle to co-operate with the ratchet.

979,485. ELECTROLYTIC CELL. Derick S. Hartshorn, Boston, and Alan A. Claflin, Medford, Mass. Filed September 27, 1910. One electrode is in the form of a series of parallel bars mounted on a band passing over two rotating cylinders so as to bring the bars slightly below the surface of the electrolyte.

979,497. MEANS FOR THE ELECTROLYTIC MANUFACTURE OF SODIUM. Paul Leon Hulin, Grenoble, France, assignor to Société d'Electro-Chimie, Paris, France, and Paul Leon Hulin, Grenoble, France. Filed October 27, 1908. The cathode consists of separated rods hanging below a circular carrier secured detachably to a fixed support. A cylindrical anode surrounds the cathode.

979,498. COMBINED BRAKE APPARATUS AND SWITCH MECHANISM. William H. Hultgren, Philadelphia, Pa., assignor to Otis Elevator Company, Jersey City, N. J. Filed June 21, 1907. Combines with an elevator, shipper sheave, and a motor therefor is brake apparatus controlled by the sheave and means movable with the sheave for holding it yieldingly in its operated position with the brake released.

979,503. ELECTRICAL TORSIOMETER. Charles Henry Johnson, Dumbarton, Scotland. Filed December 4, 1909. Comprise sleeves and disks upon the shaft, electromagnets upon the disks, the pole faces of the magnets being adjacent, an electric generator in circuit with the winding of one magnet and driven from the shaft, and a current indicator in circuit with the winding of the other magnet.

979,508. HEADLIGHT-SCREEN. Samuel Jones, Fremont, Ohio. Filed February 14, 1910. An electric headlight has a reflector for throwing most of the rays forward. An electromagnet is arranged to lift this reflector.

979,515. ELECTRICAL HEATER. Frank Kuhn, Detroit, Mich., assignor to American Electrical Heater Company, Detroit, Mich. Filed August 19, 1909. Resistance wire is wound on a split sleeve that has a tapering fit over a projection from the bottom of the liquid-containing chamber.

979,544. SHIELD FOR CIRCUIT-CONDUCTORS. Thomas E. Murray, New York, N. Y. Filed February 2, 1910. An interior-conduit connection box has a removable cover and front wall.

979,546. AUTOMATIC FEED-WATER DEVICE FOR STEAM-BOILERS. Earl E. Norman, Philadelphia, Pa., assignor to Northern Equipment Company, Chicago, Ill. Filed Aug. 20, 1908. An automatic controller for a motor-driven triplex boiler feed pump.

979,556. BLOCK-SIGNAL SYSTEM. George S. Pflasterer. Nashville, Tenn. Filed February 23, 1909. An electrically controlled three-position semaphore system.

979,569 and 980,570. TELEPHONE-CALL RECORDER. Henry K. Sandell, Chicago, Ill., assignor to Herbert S. Mills, Chicago, Ill. Filed September 24, 1909 and May 23, 1910. The register is operated by the movement of the switch-hook. An electromagnet controlled by line conditions turns operates an escapement that permits a spring to turn the register back.

979,590. TELEPHONE SYSTEM. Samuel S. Stolp, Chicago, Ill., assignor to William J. C. Kenyon, Chicago, Ill. Filed November 27, 1908. Comprises two metallic wires, a grounded battery connected to one of them, grounded signaling devices normally connected to the other conductor at the ends of the line, and means to connect the conductors at either end of the line and thereby actuate the signaling device at the opposite end thereof.

979,603. DYNAMO-ELECTRIC MACHINERY. Daniel W. Troy, Montgomery, Ala. Filed November 1, 1909. A form of homopolar dynamo.

979,605. EXHIBITOR. Walter S. Turnpaugh, Fort Worth, Tex. Filed August 12, 1910. A hollow drum carrying displays has an electric motor mounted within and rotates about a hollow shaft through which the lines wires lead to a pair of brushes.

979,608. INCANDESCENT-ELECTRIC-LAMP SOCKET. Samuel B. Van Ranst, Syracuse, N. Y., assignor to Crouse-Hinds Company, Syracuse, N. Y. Filed October 5, 1910. Has a spring conductor projecting into the socket and adapted to engage one of the lamp terminals when the lamp is partly screwed into place.

979,616. TELEPHONE-SWITCHBOARD KEY. Klas Weman, Buffalo, N. Y., assignor to Ericsson Manufacturing Company, Tonawanda, N. Y. Filed March 1, 1909. Combined with co-operating contact springs is a key-lever having a slot and a separate tip secured in the slot and adapted to engage the springs, the tip consisting of opposing approximately V-shaped halves.

979,635. ELECTRICITY METER. Hermann Aron, Charlottenburg, Germany, assignor to American Aron Electricity Meter Company. Filed April 29, 1909. Has a rotary shaft, means under the influence of the current to be measured for applying thereto a driving torque, weights supported by the shaft and freely movable relative thereto, and lifting means for the weights

fixed to the shaft and adapted to release the weights when raised to a predetermined height.

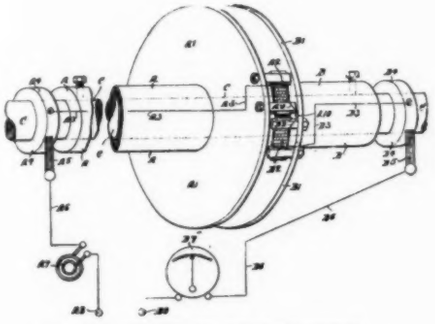
979,636. ELECTRICAL-LAMP WIRE CONNECTION. Sydney Ashdown, Vancouver, British Columbia, Canada. Filed January 11, 1910. Has means for separating the positive and negative wires of a pendent lamp circuit intermediate its ends, means adjacent thereto for separating the wires of the branch which it is desired to connect, and means for electrically connecting through suitable insulation a separated wire of each circuit without impairing the continuity of either circuit.

979,637. ELECTRIC MOTOR. Charles Backer, New York, N. Y., assignor of forty-nine one-hundredths to Rudolph Rosenfeld, New York, N. Y. Filed April 6, 1910. An electromagnet oscillates an armature which rotates a flywheel through a connecting rod and crank.

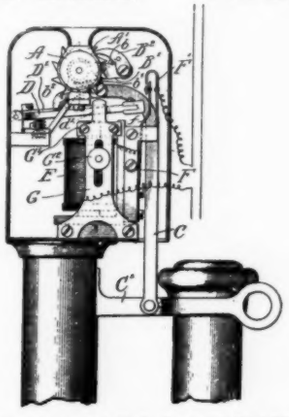
979,651. ELECTRIC-CABLE CONNECTION. Lewis H. Church, Stamford, Conn., assignor to Standard Electric Fittings Company, Stamford, Conn. Filed February 3, 1910. A fixture canopy has a hole at one side into which the cable is wedged and locked.

979,663. ELECTRIC FURNACE. Bayard Guthrie, Pittsburg, Pa., and Joseph P. Karch, Plainville, Conn. Filed March 8, 1909. Has a tiltable casing, a crucible therein, a number of electrodes supporting the crucible when pouring and means for retracting the electrodes to form an arc.

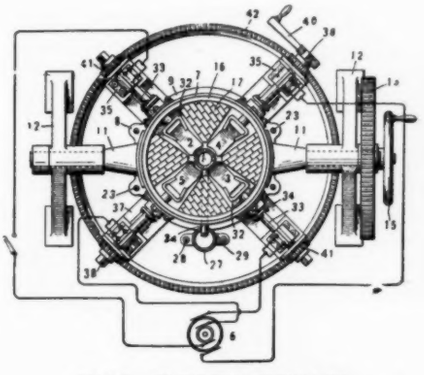
979,676. SWITCHING SYSTEM. Otto T. Lademan, Milwaukee, Wis. Filed September 2, 1909 Relates to switching devices on a party-line telephone system.



979,503.—ELECTRIC TORSIOMETER.



979,569.—TELEPHONE-CALL RECORDER.



979,663.—ELECTRIC FURNACE.

979,693. SWITCH-OPERATING DEVICE FOR LAMP-SOCKETS. Hugh E. Plunkett, Boston, Mass., assignor to James Barry, Boston, Mass. Filed April 9, 1910. A pull-switch has a sleeve projecting from the socket and a bent operating lever pivoted at its bottom and connected at its middle to a switch-moving spring in the sleeve and at its top to a pull-cord.

979,712. TROLLEY GUARD AND FINDER. Henry R. Sherman, Hartford, Conn., assignor of one-half to George H. Woodruff, New Haven, Conn. Filed June 10, 1909. A cradle with outwardly flaring sides is pivoted about the trolley wheel.

979,715. ELECTRIC PIANO-PLAYER. William Henry Smith, Penge, London, England, assignor to Joseph Herbert Marshall, London, England. Filed February 23, 1909. There is an electromagnet for operating each striker, a high resistance in series with it and a low resistance and cut-out in shunt with the high resistance. The cut-outs are pneumatically controlled.

979,720. ELECTROMECHANICAL COMPOUND BRAKE. August Sundh, Yonkers, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. Filed February 15, 1906. The secondary brake is electrically controlled.

979,750. LIFTING-MAGNET. Arthur C. Eastwood, Cleveland, Ohio. Filed July 17, 1908. Has a horizontal core with a magnet winding about it and a depending pole at each end.

979,769. ELECTRIC SIGNALING-BOX. Arthur Kempston, San Francisco, Cal. Filed February 23, 1909. A hook operates a spring-controlled train of gears and a slowly movable plunger adapted to send a signal as soon as the line is clear.

979,793. SHADE-HOLDER. Walter H. Perkins, Cheshire, Conn., assignor to Waterburg Mfg. Co., Waterbury, Conn. Filed February 26, 1910. A shade holder has a number of concentric locking rings which clasp the bottom part of a lamp socket.

979,840. INSULATOR-BASE. Walter T. Goddard, Victor, N. Y., assignor to Locke Insulator Manufacturing Company, Victor, N. Y., filed September 9, 1910. The bottom section of the insulator fits into the upper section with a ball and socket joint so that the insulator may be mounted in a vertical position even though the surface upon which it is mounted is not in a horizontal plane.

979,868. ELECTRIC RAILWAY-BRAKE. Joseph N. Mahoney, Wilkinsburg, Pa., assignor to Westinghouse Air Brake Company, Pittsburg, Pa. Filed April 20, 1908. Electric motors are so arranged as to act as generators and to produce a flow of current in a local brake circuit. Means are provided for causing a heavy rush of current through the brake circuit and then for restoring the circuit to normal.

979,894. ELECTRIC SWITCH. Roy D. Snyder, Delta, Pa. Filed May 12, 1910. An electric switch is mounted on a turntable, and may be turned around its pivot and connected to any one of a number of pairs of contacts.

979,904. ELECTRIC SOLDERING-IRON. Alvin H. Waage and Clarence P. Waage, Chicago, Ill. Filed January 28, 1910. Describes an electric soldering iron in which a coil is wound directly on the heat-conducting element.

979,905. ELECTRIC SEALING DEVICE. Johann G. Wallmann, Oakland Cal., assignor of one-half to Edward Pierce, Oakland, Cal. Filed June 27, 1910. The sealing device combines a tube having a lower portion and a contracted upper portion. Means are provided for connecting the device to a lamp socket.

979,906. ELECTROLYTIC CELL. Fritz Weinberg, New York, N. Y., assignor of two-thirds to Emile Berliner, Washington, D. C. Filed March 31, 1909. The aluminum electrode for a cell is immersed in a special forming solution, which is independent of the electrolyte which is to be used. Alternating current is passed through the electrode until an electrode of the desired type is produced.

979,912. ELECTRIC IGNITION APPARATUS FOR INTERNAL-COMBUSTION ENGINES. Frank Herbert Alston, Birmingham, England, assignor of one-half to Boultbee Brooks, Birmingham, England. Filed January 24, 1910. The ignition generator has an anti-friction current-collecting device, comprising a cup provided with races, and a ring running upon the races.

979,927. ELECTRIC-LIGHT RECEPTACLE. Henry D. Brown and Lafayette W. Blymer, Los Angeles, Cal. Filed October 6, 1909. A sign base is provided with an aperture into which an electric-light receptacle locks.

979,933. TUNGSTEN-LAMP SHOCK-ABSORBER AND ADAPTER. John H. Dale, New York, N. Y. Filed March 29, 1910. Two interconnected link-shaped members form a universal joint from which the lamp hangs, the mechanical connection being made by resilient devices.

974,934. APPARATUS FOR SEPARATING MAGNETIC MATERIALS FROM OTHER MATERIALS OR FROM LIQUIDS. Alfred Evan Davies, Birmingham, England. Filed December 28, 1908. This device includes a tray, means for magnetizing the tray, a supplemental tray adapted for insertion in the first-named tray, a portion of the bottom of the supplemental tray being adapted to be magnetized by induction from the first-mentioned tray.

979,940. TROLLEY-STAND. Charles M. Feist, Sioux City, Iowa, assignor of forty-nine one-hundredths to Edwin L. Kirk, Sioux City, Iowa. Filed April 13, 1910. The trolley stand is provided with a dished base suitable for the retention of lubricant, and a series of elongated anti-friction rollers so that the stand is easily rotated.

979,970. METHOD OF ELECTRIC WELDING. Laurence S. Lachman, New York, N. Y., assignor to Universal Electric Welding Company. Filed October 17, 1906. This process concerns the welding of two pieces of metal of which one piece fits into a slot formed in the other. The pieces are thus held tightly together, and when current is passed through the combined pieces the adjoining surfaces are, due to their small area, heated up to a welding heat.

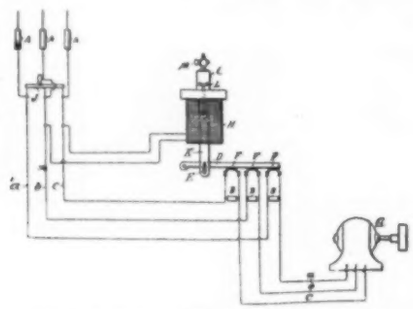
979,977. ELECTRIC FIRE-ALARM. Emmett Mahon, Fairfield, Iowa. Filed July 13, 1909. A small receptacle which is filled with an enpansible liquid, supports a float. Normally the circuit, which includes the float and the upper part of the device, is open. On the liquid becoming heated, it expands and permanently holds the two contacts together ringing suitable alarm devices.

979,986. TELEPHONE RELAY OR REPEATER. Howard Morgan, Quinter, Kan. Filed May 19, 1909. A frame with two sets of electromagnets is so arranged that on the energization of either set of magnets corresponding induced currents will be set up in the other set.

979,999. APPARATUS FOR THE STERILIZATION OF WATER OR OTHER LIQUIDS. Casimir Stanislas Piestrak, Paris, France. Filed August 29, 1910. Water or other liquids are sterilized by passing over them ozone generated around a specially constructed mercury-vapor lamp.

980,024. TELEPHONE-RECEIVER. Wilbur H. Thompson, Wheeling, W. Va., and Harve R. Stuart, Milwaukee, Wis. Filed June 11, 1909. A telephone receiver has an oval permanent magnet having consequent poles, a pair of bifurcated pole pieces projecting from the poles, a pair of solenoids joining the extremities of the respective pole pieces, extensions from the pole pieces entering the solenoids into close proximity to one another, and diapragms actuated by the varying attraction between these extensions.

980,032. ROTOR FOR HIGH-SPEED ELECTRICAL MACHINES. Henry H. Walt, Chicago, Ill. Filed March 11, 1907. A rotor for high speed electrical machines comprises a core, windings on the core, end connections for the windings, and an annular connection-box at the end of the rotor in which the end connections are disposed. The connection box comprises a hollow central supporting drum, end plates supporting upon the drum at both ends, and a retaining ring fitted upon the end plates



980,090.—SAFETY CUT-OUT FOR MOTORS.

and supported by it, the end-plate nearest the core being slotted for the passage of the windings.

980,042. TELEPHONE-TRANSMITTER. Charles Adams-Randall, New York, N. Y. Original application filed April 14, 1905. Divided and this application filed August 31, 1907. The telephone transmitter described has a diaphragm, a plurality of independent variable resistances insulated from the diaphragm, independent co-operating electrodes insulated from one another and from the diaphragm and engaging the independent variable resistances or electrodes carried by the diaphragm, and means for connecting in series, in whole or in part, the resistances or electrodes carried by the diaphragm and the independent co-operating electrodes so that the internal resistance of the transmitter may be varied.

980,090. SAFETY APPLIANCE FOR MOTORS. Paris R. Forman, Chicago, Ill., assignor to Burdett-Rowntree Manufacturing Company, Chicago, Ill. Filed November 23, 1909. The motor circuit is provided with fuses of large capacity and fuses of comparatively small capacity. Normally the smaller fuses are short-circuited but the short circuit is removed automatically and the smaller fuses connected directly in the motor circuit.

980,109. MOTOR CONTROL. David L. Lindquist, Yonkers, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. Filed May 7, 1908. Electro-magnetic brake apparatus is combined with an alternating-current motor and the motor speed is controlled by means dependent on the magnetic reluctance of the motor.

980,118. TELEGRAPH APPARATUS. John B. Odell, Chicago, Ill., assignor of one-half to Arthur G. Leonard, Chicago, Ill. Filed December 21, 1907. A ratchet wheel is combined with a member which may be variably shifted. A shiftable connector is set between the ratchet wheel and the member. The device includes a selecting magnet, a spring-held armature vibrated by the magnet, a push pawl and a pull pawl pivoted to the armature and engaging the teeth of the ratchet wheel, to shift this ratchet wheel and the member one step when the armature is shifted in either direction, and means for shifting the connector to permit the return of the member to normal position.

980,129. AUTOMATIC FEEDER-REGULATOR. Benjamin Parks Rucker, Charlotte, N. C. Filed April 1, 1910. The device includes a regulating transformer, a moveable member and a voltmeter with an indicating needle so arranged that when the voltage falls below normal the needle engages one arm of the regulator, and when the voltage rises above normal the other arm is engaged. At normal voltage the needle is free.

980,153. MAGNETO-ELECTRIC GENERATOR. Thomas S. Hemenway, Buffalo, N. Y., assignor to Ericsson Manufacturing Company, Tonawanda, N. Y. Filed May 25, 1908. The magneto is provided with a shaft which may be shifted horizontally.

980,156. STEERING MEANS FOR VESSELS. Harry Hertzberg and Maurice J. Wohl, New York, N. Y., assignors to Maurice J. Wohl and Harry Hertzberg, New York, N. Y., and Abbot A. Low, Horseshoe, N. Y., trustees. Filed December 12, 1908. The ship is steered by a number of independently operated propellors which may be controlled automatically by the compass.

980,164. AUTOMATIC CALIPERING ATTACHMENT. Henry B. Nichols, Philadelphia, Pa. Original applications filed September 5, 1908, and January 14, 1909. Divided and this application filed December 27, 1909. The feed mechanism on a grinding machine is controlled by an automatic caliper which makes use of electrical contacts in the caliper fingers.

REISSUE.

13,186. ELECTRIC FURNACE FOR METALLURGICAL PURPOSES. Paul Girod, Ugine, France. Filed August 5 ,1909. Original No. 921,228, dated May 11, 1909. An electric metallurgical furnace comprises a refractory working hearth, a lower electrode, means for causing part of the metal to unite with the same, and an upper electrode held in contact with the slag but out of contact with the fused metal.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired January 2, 1911:

511,758. ELECTRIC MOTOR. Walter A. Crowdus, Chicago, Ill.
511,787. SELF-CLOSING TELEGRAPH-KEY. Henry E. Moss, Kansas City, Mo.
511,821 and 511,822. STORAGE-BATTERY SYSTEM OF DISTRIBUTION. Jakob Trumpy, Hagen, Germany.
511,824. TROLLEY MECHANISM FOR ELECTRICALLY-PROPELLED VEHICLES. Curtis H. Veeder, Lynn, Mass.
511,855. ELECTRO HYDROCARBON-ENGINE. Lee C. Mann, Gladbrook, Iowa.
511,862. ELECTRIC LOCOMOTIVE FOR ELEVATED TRACKS. Charles H. Roberts, Hartwell, Ohio.
511,866. ELECTRIC ALARM FOR CANE-FEEDERS. August F. Slangerup, New Orleans, La.
511,873. ELECTRIC-CIRCUIT CONTROLLER. Romaine Callender, Brantford, Canada.
511,874 and 511,875. TELEPHONE-EXCHANGE SYSTEM. Romaine Callender, Brantford, Canada.
511,882. TELEPHONE TRANSMITTER. Stephen C. Drew, Boston, Mass.
511,883. REGISTERING APPARATUS FOR TELEPHONES. Angelo R. Duperu, San Francisco, Cal.
511,889. ELECTRIC SWITCH. Jesse L. Hinds, Syracuse, N. Y.
511,915. ELECTRICAL TRANSMISSION OF POWER. Nikola Tesla, New York, N. Y.
511,916. ELECTRIC GENERATOR. Nikola Tesla, New York, N. Y.
511,928. SECTION-INSULATOR. Henry M. Brockbank, Brooklyn, N. Y.
511,946. ELECTRIC CLOCK. Fred L. Gregory, Niagara Falls, N. Y.
511,953. PUSH-BUTTON. Charles D. Hunking, New York, N. Y.
511,988. ELECTRIC LOCOMOTIVE. Edward M. Bentley, Boston, Mass.
512,013. ELECTRIC-STOP MOTION FOR WARPING-MACHINES. Clayton Denn, John Cocker and Charles Denn, Philadelphia, Pa.
512,027. REGULATOR FOR CONTINUOUS CURRENT ARC-LIGHT CIRCUITS. Daniel Highman, Boston, Mass.
512,050 and 512,051. ELECTRICALLY-CONTROLLED RAILWAY-SIGNAL. Frank McBrien, Newark, N. J.
512,077. ELECTRICALLY-CONTROLLED RAILWAY-SIGNAL. James Wayland, Newark, N. J.
512,102. TRANSMISSION OF RAPIDLY-ALTERNATING ELECTRIC CURRENTS. William H. Eckert, New York, N. Y.
512,115. ELECTRIC-CURRENT REGULATOR. Ansel B. Jones, Cleveland, Ohio.
512,214. COMPOSITE TELEPHONIC AND MULTIPLE-TELEGRAPHIC TRANSMISSION. Frank A. Pickernell, Newark, N. J.
512,217. ELECTRIC CALL. Purdy M. Randall, Concord, N. H.
512,227. REGULATOR FOR DYNAMO-ELECTRIC MACHINES. Charles E. Scribner, Chicago, Ill.
N. H.
512,253. SECONDARY BATTERY. William C. Lockwood, New York, N. Y.
512,250. ELECTRIC INDICATOR. Adrian H. Hoyt, Manchester,
11,397 and 11,398. ELECTRIC CONNECTION. Hercules Sanche, Detroit, Mich.